

## Interplanetary Type IV Bursts

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**Abstract** We study the characteristics of moving type IV radio bursts which extend to the hectometric wavelengths (interplanetary type IV or type IV<sub>IP</sub> bursts) and their relationship with energetic phenomena on the Sun. Our dataset comprises 48 interplanetary type IV bursts observed with the Radio and Plasma Wave Investigation (WAVES) instrument onboard Wind in the 13.825 MHz–20 kHz frequency range. The dynamic spectra of the *Radio Solar Telescope Network* (RSTN), the *Nançay Decametric Array* (DAM), the *Appareil de Routine pour le Traitement et l' Enregistrement Magnetique de l' Information Spectral* (ARTEMIS-IV), the Culgoora, Hiraiso and Izmiran *Radio Spectrographs* were used to track the evolution of the events in the low corona. These were supplemented with soft X-ray (SXR) flux-measurements from the *Geostationary Operational Environmental Satellite* (GOES) and coronal mass ejections (CME) data from the *Large Angle and Spectroscopic Coronagraph* (LASCO) onboard the *Solar and Heliospheric Observatory* (SOHO). Positional information of the coronal bursts was obtained by the *Nançay radioheliograph* (NRH). We examined the relationship of the type IV events with coronal radio bursts, CMEs and SXR flares. The majority of the events (45) were characterized as compact; their duration was on average 106 minutes. This type of events was, mostly, associated with M- and X-class flares (40 out of 45) and fast CMEs; 32 of these events had CMEs faster than 1000 km s<sup>-1</sup>. Furthermore, in 43 compact events the CME was, possibly, subjected to reduced aerodynamic drag as it was propagating in the wake of a previous CME. A minority (three) of long lived type IV<sub>IP</sub> bursts was detected, with duration from 960 minutes to 115 hours. These events are referred to as extended or long duration and appear to replenish their energetic electron content, possibly from electrons escaping from the corresponding coronal type IV bursts. The latter were found to persist on the disk, for tens of hours to days. Prominent among them was the unusual interplanetary type IV burst of 18-23 May 2002, which is the longest event in the *Wind*/WAVES catalog. The three extended events were, usually, accompanied by a number of flares,

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of GOES class C in their majority, and of CMEs, many of which were slow and narrow.

**Keywords:** Radio bursts. Dynamic spectrum. Meter and longer wavelengths. Coronal mass ejections

## 1. Introduction

Solar metric radio bursts provide a unique diagnostic of the development of flare/coronal mass ejection (CME) events in the low corona. Their onset and evolution, is accompanied by energetic-particle acceleration and injection into interplanetary (IP) space as well as shocks (see *e.g.* the review by Pick and Vilmer, 2008; Nindos *et al.*, 2008). Their signatures at metric to kilometric wavelengths trace disturbances propagating from the low corona to the interplanetary space.

Three types of nonthermal radio bursts are associated with the CME/flare Events (Sakurai, 1974; White, 2007; Gopalswamy, 2011):

- Bursts of the type III family. They are produced by energetic electrons accelerated in the Sun and traversing the solar atmosphere, along coronal magnetic lines rooted in its surface. In open field lines, they may escape into the interplanetary space (see, for example, Figure. 1 of Klein *et al.* (2008), also Alissandrakis *et al.* (2015)). In the dynamic spectra, these standard type III bursts appear as fast drifting bands ( $df/ft \approx 1.0s^{-1}$ ). When trapped in closed magnetic structures, they eventually turn toward the Sun, resulting in inverted U- or J-shaped bursts in the dynamic spectra (hence type-U or J bursts of the type III family). Often, in flare/CME events, the transition from the type-U and J bursts to the typical type III mark the restructuring, or opening, of the magnetic field lines as originally confined, energetic electrons gain access to open magnetic lines. An example of dynamic radio spectra showing this transition from U and J-type bursts to a standard type III burst at the beginning of the 17 January 2005 event can be found in Hillaris *et al.* (2011). In the hectometric and kilometric regime, long duration storms of individual type III bursts (Fainberg and Stone, 1970a,b, 1971; Bougeret, Fainberg, and Stone, 1983) covering several days (5.4 on average after Kayser *et al.*, 1987) were recorded. These are distinct from the hectometric–kilometric extensions of type III bursts and are known as IP storms and, more often than not, may appear as storm continua on the dynamic spectra. The individual type III components of the IP storms, (micro-type III bursts, after Morioka *et al.*, 2007) are significantly weaker than the typical type III bursts in the same frequency range. The IP storms are well associated with active regions (Kayser *et al.*, 1987) yet the micro-type III bursts are not accompanied by significant SXR flare activity. This implies the need of a persistent coronal store of suprathermal electrons (Bougeret, Fainberg, and Stone, 1984a,b) supplying this type of activity.

- Type II bursts. They are the radio signatures of the passage of a magneto-hydrodynamic (MHD) shock wave through the tenuous plasma of the solar corona; their radio emission is due to energetic electrons accelerated at the shock front. It is, in general, accepted that type II bursts at decametric and longer wavelengths are driven by CMEs, bow or flank (Vršnak and Cliver, 2008). At the metric range, on the other hand, they might be also due, apart from CMEs, to flare blasts (Cane and Reames, 1988; Nindos *et al.*, 2011; Magdalenić *et al.*, 2010, 2012) or reconnection outflow termination-shocks (Aurass, Vršnak, and Mann, 2002).
- Type IV bursts. They are radio continua due to the radiation of energetic electrons trapped within magnetic structures and plasmoids. They have been recorded in almost all frequency ranges starting from the microwaves as type IV $\mu$  bursts and the decimetric range as type IVdm (Benz, 1980). In the metric wavelengths the type IVm bursts are divided into moving (IVmA or IVM) and stationary (IVmB). The type IVmB bursts emanate from stationary magnetic structures usually located above active regions or post-eruption arcades behind CMEs (Robinson, 1985; Gopalswamy, 2011). The type IVm burst are, sometimes, referenced as flare continua (FCM when preceding a type IVmA or FCII when following a type II burst, see Robinson, 1978). They are also identified as continuum noise storms (type IVsA and IVsB, corresponding to type IVmA and IVmB, see discussion in Sakurai, 1974, and their Figure 14). The type IVmA bursts (Boischot, 1957) appear moving outwards at velocities of the order of 100–1000 km s<sup>-1</sup> comparable to CME speeds (White, 2007); they sometimes last more than ten minutes. A number of these are believed to originate within the densest substructures of CMEs (Klein and Mouradian, 2002; Bastian *et al.*, 2001; Aurass *et al.*, 1999; Bain *et al.*, 2014). These substructures are, possibly, erupting prominences within the CMEs. The type IVmA burst—CME association was found to increase with the speed of the CME (Gergely, 1986, and references therein). A subset of the moving type IV radio bursts extend, in dynamic spectra, to the hectometric wavelengths (frequencies lower than  $\approx 20$  MHz) and are recorded with the *Radio and Plasma Wave Investigation* (WAVES) instrument onboard *Wind*; these are interplanetary type IV or IV<sub>IP</sub> radio bursts.

In this article we examine the characteristics and the evolution of interplanetary type IV bursts and their relationship with energetic phenomena on the Sun such as flares and CMEs. The data used are from the *Wind*/WAVES receivers and a number of ground based instruments. From the combined datasets an extensive table of type IV<sub>IP</sub> and associated activity was compiled and is presented as supplementary online material (file IPtypeIV.pdf). A detailed description of the table is included in the Appendix. The question addressed in our study is twofold. Firstly, we examine the association of these bursts with intense flares and fast CMEs, examining whether they may be considered as another aspect of the big flare syndrome first introduced by Kahler (1982). Secondly, we search for other processes affecting, totally or partially, the appearance of this type of radio bursts.

This report on interplanetary type IV (or Type-IV<sub>IP</sub>) bursts is structured as follows. In Section 2 we describe the instrumentation and dataset used in our study. The data analysis is presented in Section 3 including an overview of selected events in Sections 3.3, 3.4, and 3.5. In Section 4 we present the characteristics and the evolution of different types of type IV<sub>IP</sub> events which, then, are discussed in Section 5. The conclusions are presented in the same section.

## 2. Observations and Data Selection

The basic data used in this study are dynamic spectra recorded by the R1 and R2 receivers of the *Wind*/WAVES (Bougeret *et al.*, 1995) in the 20kHz–13.825 MHz frequency range from 1998 to 2012. The interplanetary type IV bursts selected were already identified in the *Wind*/WAVES online catalog<sup>1</sup>. The observations were complemented by data in the metric and decametric wavelengths from the following ground-based radio observatories:

- The *Artemis-IV radio-spectrograph*<sup>2</sup> (Caroubalos *et al.*, 2001; Kontogeorgos *et al.*, 2006a,b, 2008, observes in the frequency range 20–650 MHz.).
- The *Culgoora radio-spectrograph* (Prestage *et al.*, 1994, observes in the frequency range 18–1800 MHz.).
- The *Nançay Decametric Array or DAM*<sup>3</sup> (Boischot *et al.*, 1980; Lecacheux, 2000, observes in the range 20–75 MHz.).
- The *Nançay Radioheliograph* (NRH: Kerdraon and Delouis, 1997) provides daily, 09:00–15:30 UT, two-dimensional images of the Sun at ten frequencies from 450 to 150 MHz with sub-second time resolution. It was used for positional information of the metric–decametric radio emission. In this article the quick-look-style NRH data from the radio-monitoring site<sup>4</sup> were used.
- The *Hiraiso Radio Spectrograph*<sup>5</sup> (HiRAS: Kondo *et al.*, 1995) observes in the frequency range 25–2500 MHz.
- The *Institute of Terrestrial Magnetism, Ionosphere and Radio Wave Propagation (IZMIRAN) Radio Spectrograph*<sup>6</sup> (Gorgutsa *et al.*, 2001) observes in the range 25–270 MHz.
- The *Radio Solar Telescope Network*<sup>7</sup> (RSTN: Guidice *et al.*, 1981) with a number of solar radio observatories at various locations around the world guarantees full, 24 hours, coverage.:

<sup>1</sup>[www.lep.gsfc.nasa.gov/waves/data\\_products.html](http://www.lep.gsfc.nasa.gov/waves/data_products.html)

<sup>2</sup>Appareil de Routine pour le Traitement et l' Enregistrement Magnetique de l' Information Spectral, <http://artemis-iv.phys.uoa.gr/>

<sup>3</sup>[bass2000.obspm.fr/home.php](http://bass2000.obspm.fr/home.php)

<sup>4</sup>[http://radio-monitoring.obspm.fr/nrh\\_data.php](http://radio-monitoring.obspm.fr/nrh_data.php)

<sup>5</sup>[sunbase.nict.go.jp/solar/denpa/index.html](http://sunbase.nict.go.jp/solar/denpa/index.html)

<sup>6</sup>[www.izmiran.ru/stp/lars/](http://www.izmiran.ru/stp/lars/)

<sup>7</sup>[ftp://ftp.ngdc.noaa.gov/STP/space-weather/solar-data/solar-features/solar-radio/rstn-spectral](http://ftp.ngdc.noaa.gov/STP/space-weather/solar-data/solar-features/solar-radio/rstn-spectral)



- Sagamore Hill at Hamilton, Massachusetts, USA ( $42^{\circ}33'N$   $70^{\circ}49'W$ )
- Halehale at Kaena Point, Hawaii ( $21^{\circ}24'N$   $158^{\circ}06'W$ )
- Holloman at New Mexico, USA ( $32^{\circ}51'N$   $106^{\circ}06'W$ )
- Learmonth at Western Australia, Australia ( $22^{\circ}13'S$ – $114^{\circ}06'E$ )
- San Vito dei Normanni, Italy ( $40^{\circ}39'N$   $17^{\circ}42'E$ )

These observatories provide dynamic spectra in the 25–180 MHz range.

Additional datasets were used in order to examine the association of the type IV<sub>IP</sub> bursts with the evolution of flares and CMEs:

- CME data from the *Large Angle and Spectroscopic Coronagraph* (LASCO) Catalogue on line<sup>8</sup> (Yashiro *et al.*, 2004; Gopalswamy *et al.*, 2009)
- SXR (*Geostationary Operational Environmental Satellite*, GOES) characteristics from on line reports<sup>9</sup> and light curves<sup>10</sup>.
- Images from the *Extreme Ultraviolet Imaging Telescope* (EIT: Delaboudinière *et al.*, 1995) onboard the *Solar and Heliospheric Observatory* SOHO. They were used in order to provide information on flare positions.

From the *Wind*/WAVES catalog all events indicated as bursts of type IV<sub>IP</sub> (48 in total) were selected. Many (36) were accompanied by interplanetary type II shocks.

A comprehensive list of the interplanetary type IV bursts and the associated activity including, but not restricted to, coronal burst, flare and CME data is attached as supplementary online material (file IPtypeIV.pdf). A detailed description of the table is included in the Appendix. In compiling this catalog, we included information of all the *Wind*/WAVES type IV<sub>IP</sub> bursts, their associated CMEs and SXR flares in the 1998–2012 period and the accompanying interplanetary type II and coronal type II, IV and III bursts. The above mentioned CMEs which are thought to drive the type IV<sub>IP</sub> bursts are referred to as main CMEs in order to distinguish from preceding CMEs along the same path; the latter were included in the table as they may affect the appearance of type IV<sub>IP</sub> bursts as discussed in Sections 4.1 and 5. The selection of the CMEs preceding the main ejection along the same path is based on a time interval of about 48 hours before the main CME and whether the sectors (or cones in 3D) defined by position angle and width for the main and the preceding CME overlap. Occasionally there are more than one preceding CMEs included in the catalog because they are all within the 48 hours window and they appear to overlap, in part, with the main CME. The overlap criterion is relaxed when one or both the main and the preceding CMEs are halo CMEs; in this case we assume that an overlap is always possible, at least in part.

The catalog format is described, in detail, in the appendix.

<sup>8</sup>[http://cdaw.gsfc.nasa.gov/CME\\_list](http://cdaw.gsfc.nasa.gov/CME_list)

<sup>9</sup><ftp://ftp.ngdc.noaa.gov/STP/space-weather/solar-data/solar-features/solar-flares/x-rays/> and <https://solarmonitor.org/data>

<sup>10</sup><http://satdat.ngdc.noaa.gov/sem/goes/data/>

### 3. Data Analysis

#### 3.1. Data Processing

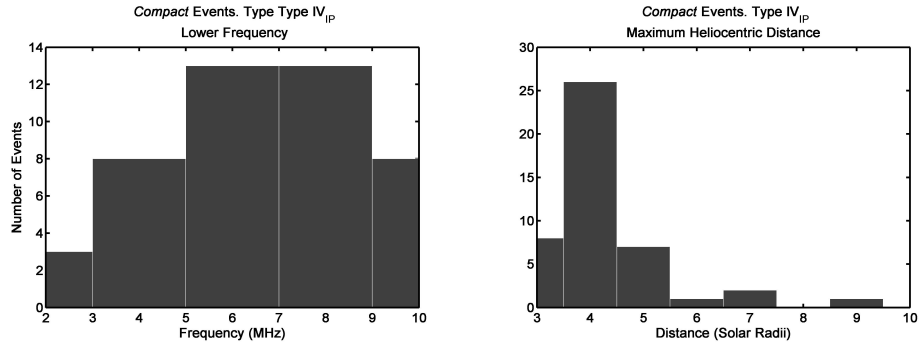
The combination of hectometric dynamic spectra by *Wind*/WAVES with metric and decametric spectra from the ground-based radio spectrographs (see Section 2) was, firstly, plotted as a composite dynamic spectrum. These were found to include an amount of features, mostly groups of type III and II bursts, embedded in a slowly varying background. Often the continuum background was removed by the use of high-pass filtering on the dynamic spectra (usually differentiation). This filtering, however, amplifies the high-frequency noises therefore the smoothed differentiation filter of Usui and Amidror (1982) was used. This performs simultaneously a smoothing and differentiation so it can be regarded as a low-pass differentiation filter (digital differentiator) appropriate for experimental (noisy) data processing.

The composite dynamic spectra provide an overview of the evolution of the type IV<sub>IP</sub> bursts under study, and of the accompanying radio activity, from the corona to the interplanetary space. On each dynamic spectrum several time-histories were superposed:

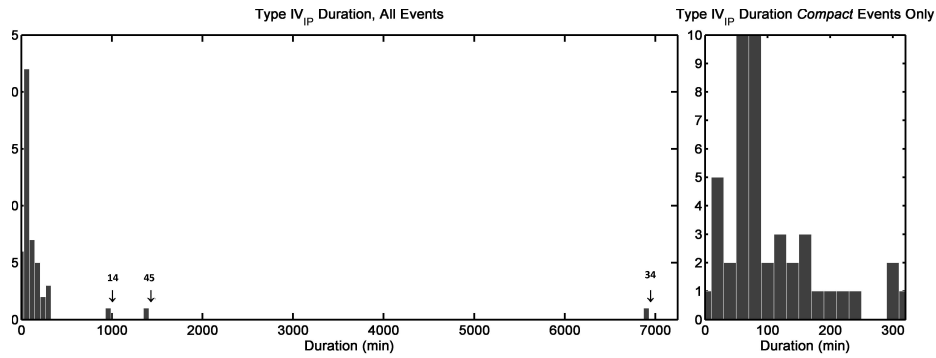
- The approximate frequency–time trajectories of the CME fronts. These were plotted on the dynamic spectra, using the coronal density model of Vršnak, Magdalenić, and Zlobec (2004), as dashed lines. The selection details for the model are presented in Section 3.2. The linear fits to the height–time trajectories of the CME fronts, from the LASCO images, were converted to the frequency–time traces of the fundamental and harmonic plasma emission; the squares mark the measured positions of the CME front.
- The GOES SXR time–profiles: The solid black (1.0–8.0 Å) and the dotted purple (0.5–4.0 Å) curves display the SXR time history describing thermal emission from the hot flare plasma.

Of the 48 type IV<sub>IP</sub> bursts of this report 17 overlapped, at least partly, with the NRH window of observation. For these the position of the coronal extension (metric type IV burst) of the interplanetary burst was compared to the SXR flare position and the solar sources of the CME in the EIT images. Their spatial relationship was, thus, established. This was obtained by a combination of NRH radio contours overlayed on the EIT 195 Å difference image and combined with the LASCO difference image. Two categories of type IV<sub>IP</sub> bursts were found:

Compact type IV<sub>IP</sub> bursts. These were, mostly, associated with M- and X-class flares and fast CMEs; their duration was on average 100 ( $\pm 11$ ) minutes. Their minimum frequency was in the 10–2 MHz range which corresponds to 3–10  $R_{\odot}$  heliocentric distances. The distribution of the low frequency limits and the corresponding distances, derived from the calculations in Section 3.2, are exhibited in Figure 1. In total, 45 of these events were found in the *Wind*/WAVES lists. An example is presented in Section 3.3.



**Figure 1.** Left panel: Distribution of the low frequency limit of the compact interplanetary type IV bursts. Right panel: The corresponding heliocentric distance of these type IV bursts based on the low frequency limit and the model dependent calculations described in Section 3.2.



**Figure 2.** Distribution of the duration of the interplanetary type IV bursts. Left panel: All (48) events; the three extended events are pointed with arrows. Their catalog numbers are shown above them. Right panel: Histogram including only the 45 compact events

Long Duration or *Extended* type IV<sub>IP</sub> bursts. They represent a small minority of three events with durations from 960 minutes to 115 hours. Their morphology was found to be less uniform than that of their majority counterparts. Two of them (catalog numbers 34, 18–23 May 2002, and 45, 27 May 1999, described in Sections 3.4 and 3.5) were accompanied by a sequence of small flares and slow and narrow CMEs with an occasional medium or large flare within the sequence. Another event (number 14, 17 January 2005, presented in Section 3.6) originated from a fast CME and large flare, but extended far beyond the duration of a compact event.

The distribution of the interplanetary type IV bursts duration is presented in Figure 2 for all the events of the study. The three extended events are the outliers of the histogram on the left panel. The distribution of the duration of the compact events is also presented, separately, on the right panel of Figure 2. In Section 4 the differences between the characteristics of the extended and the compact events, apart from their duration, are examined and discussed.

### 3.2. Coronal Density–Height Model Selection

As plasma emission depends on electron density, which in turn may be converted to coronal height using density models, we may calculate the radio source heights and speeds from the dynamic spectra. The establishment of a correspondence between frequency of observation–coronal height and frequency drift rate–radial speed is affected by ambiguities introduced by the variation of the ambient medium properties. These may be the result of the burst exciter propagation within undisturbed plasma, over-dense or under-dense structure or CME after-flows (see Pohjolainen *et al.*, 2007; Pohjolainen, Hori, and Sakurai, 2008, for a detailed discussion on model selection).

The density model of Vršnak, Magdalenic, and Zlobec (2004).

$$\frac{n}{10^8 \text{ cm}^{-3}} = 15.45 \left( \frac{R_{\odot}}{R} \right)^{16} + 3.165 \left( \frac{R_{\odot}}{R} \right)^6 + 1.0 \left( \frac{R_{\odot}}{R} \right)^4 + 0.0033 \left( \frac{R_{\odot}}{R} \right)^2,$$

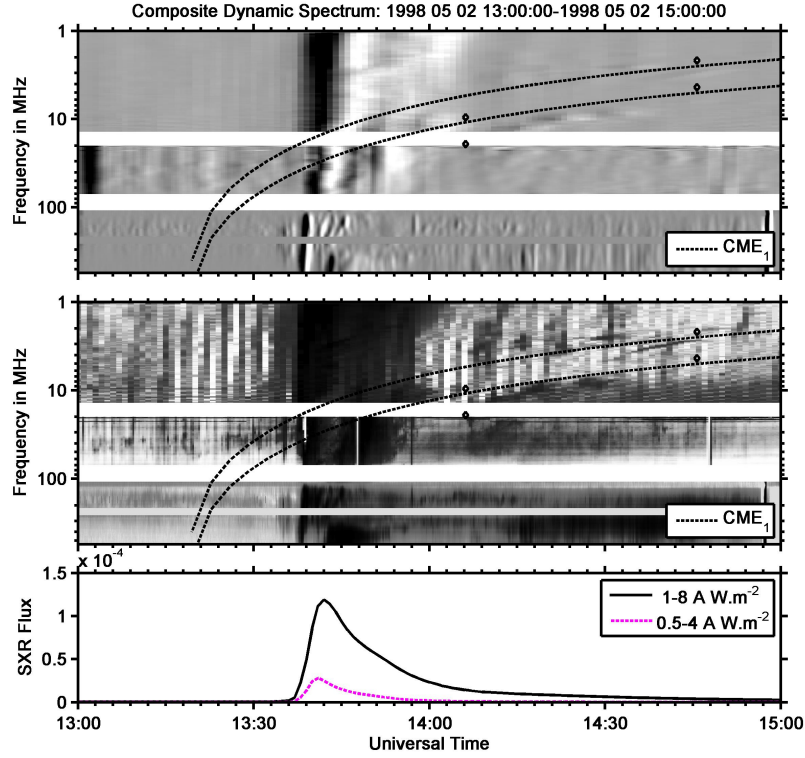
which describes well the coronal density behavior in the large range of distances from low corona to interplanetary space was used for the conversion of the linear fits to the height-time trajectories of the LASCO CME fronts to frequency-time tracks on the composite dynamic spectra.

### 3.3. Overview of the 2 May 1998 Compact Event Evolution

The 2 May 1998 compact event (catalog number 47) is typical of its class. It has drawn considerable attention due to the large number of instruments that have observed it, including *Wind*/WAVES, SOHO/LASCO, EIT, NRH, and several radio spectrographs. It is reported in a number of articles which focus, mainly, on the solar surface magnetic waves (Zharkova and Kosovichev, 1999), the pre-CME launch activity (Pohjolainen, Khan, and Vilmer, 1999) and the on disk development of the CME (Pohjolainen *et al.*, 2001).

The interplanetary type IV event (see composite spectrum in Figure 3) starts at 14:10 UT on 02 May and lasts until 15:40 UT of the same day in the frequency range 8–14 MHz. An interplanetary type II burst was recorded from 14:25–14:50 UT in the 5–3 MHz range the *Wind*/WAVES. In the catalog it is described as a narrowband wisp yet it is well associated with the front of the CME. Another type II, without apparent association to the CME front, appears in the 400–6 MHz range, recorded by the *ARTEMIS-IV*, the *Nançay Decametric Array* (DAM) and the *Wind*/WAVES from 13:30–13:46 UT. It exhibits a multiple band structure and was first reported by Pohjolainen *et al.* (2001). The high frequency extension of the type IV<sub>IP</sub> was recorded by the DAM and the *ARTEMIS-IV* radio spectrographs and extends above the 500 MHz (see also Pohjolainen *et al.*, 2001, their Figure 8). This activity is accompanied by an X1.1/3B-class flare from active region AR 8210 at heliographic coordinates S15W15; the flare started at 13:31 and ended at 13:51 UT peaking at 13:42 UT.

The NRH records at 432 and 164 MHz indicate that the type IV continuum appears over AR 8210 and, on the 164 MHz images, starts moving northwards at 13:34 UT. This is consistent with the movement of a rather fast, 938 km



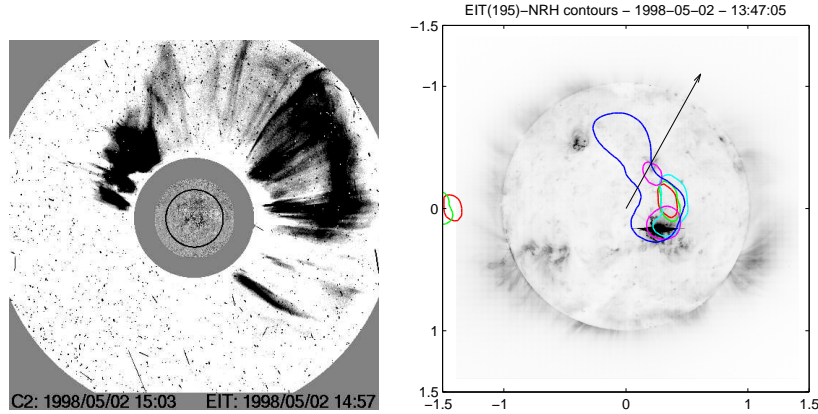
**Figure 3.** 02 May 1998 event.. Top pannel: *Wind*/WAVES *ARTEMIS-IV* differential spectrum (inverse grey scale). Middle Panel: Dynamic (intensity, inverse grey scale) spectrum. The frequency-time plots derived from the linear fits to the front trajectory of the associated CME and an empirical density model (see Section 3.2) for the fundamental and harmonic (dashed curves) plasma emission are overlayed on the spectra. Bottom Panel: The profiles of GOES SXR 1-8 Å (solid-black line) and 0.4-4 Å (dashed-red line) flux.

$s^{-1}$  halo CME (first view at 14:06 UT, back extrapolated lift-off at 13:07 UT) with measured position angle  $331^\circ$  (see Figure 4). This CME appears driving the fundamental and harmonic pair, mentioned in the previous paragraph. As regards the CME path, there are two preceding halo CMEs on 02 May 1998 at 05:32 UT and on 01 May 1998 at 23:40 UT.

The broadband dynamic spectra and the NRH images indicate that the compact interplanetary type IV burst is associated with an X-class flare and a fast halo CME. The latter propagates in the wake of a previous halo CME which was launched approximately eight and a half hours before. This example represents the combined effects of an intense flare and fast CME event with the CME propagating within a low-drag region due to the passage of a previous CME.

### 3.4. Overview of the 18–22 May 2002 Extended Event Evolution

The type IV<sub>IP</sub> event starts at 09:00 UT on 18 May and lasts until 04:00 UT on 23 May in the frequency range 0.3–9 MHz (catalog number 34). It was the only such

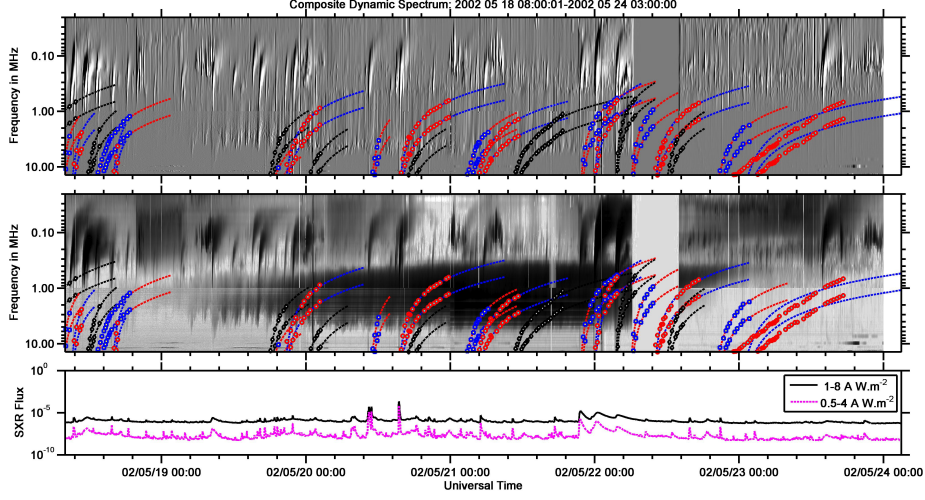


**Figure 4.** Left: LASCO and EIT 195 Å running difference frames of the 02 May 1998 14:06 UT CME (inverse gray scale). Right: NRH half power contours (at 432 (red), 410 (green), 327 (cyan), 236 (magenta), and 164 (blue) MHz). The contours were recorded at successive times starting with 432 MHz at 13:47:05 UT to 164 MHz at 13:51:53 UT, thus tracing the outward motion of the type IV burst. The arrow indicates the halo CME measured position angle from the LASCO catalog.

event observed by *Wind*/WAVES in its years of operation (Reiner *et al.*, 2006). An interplanetary type II burst was recorded from the 22 May at 04:10 UT until the 23 May 10:10 UT in the 0.5–0.03 MHz range. The *Wind*/WAVES dynamic and differential spectra, with the CME front trajectories overlayed, and the SXR flux are exhibited in Figure 5; details in the period 07:45–12:45 UT on 19 May are presented in Figure 6. This event was briefly reported by Gopalswamy (2004) who, based on polarization measurements, considers a hectometric storm continuum and not a type IV<sub>IP</sub> burst as reported in the *Wind*/WAVES catalog.

On the solar disk, we see a number of active-region complexes in the 18–23 May period. When the continuum started, on 18 May AR 9957 (N08E47) was the largest and most complex region on the disk. This region was accompanied by AR 9958 (N04E45) and followed by AR 9960 at N05E74 and AR 9962, AR 9963 which appeared on the 21 May at N15E47 and N17E63. South of this group were AR 9954 (S22E35), AR 9955 (S14E37) and in the western hemisphere AR 9945 (S02W73), AR 9948 (S21W20) and AR 9950 (S05W42). On the left panel of Figure 7 we present the positions of all SXR flares within the 18–23 period and of the corresponding active regions.

Throughout the period of interest from 18 May 2002 at 02:44 UT to 23 May 2002 at 04:00 UT, 38 SXR flares were recorded by GOES, positional data were obtained for 33 of them. The AR 9957, AR 9958, AR 9960, AR 9962, AR 9963 complex, located in the NE quadrant of the disk, gave 10 C-class and one M1.5 SXR flares. The single AR 9961 in the SE quadrant gave 16 flares (including an X2.1 and an M5.0) on 19 May 2002 at 15:54 UT. Within the same period 24 CMEs were recorded in the LASCO catalog. The positional angles indicate that they emerged from all quadrants of the solar disk. This activity was associated with many type III burst-groups, 2–3 type II shocks in the metric range (see the table included as supplementary online material) and a persistent continuum



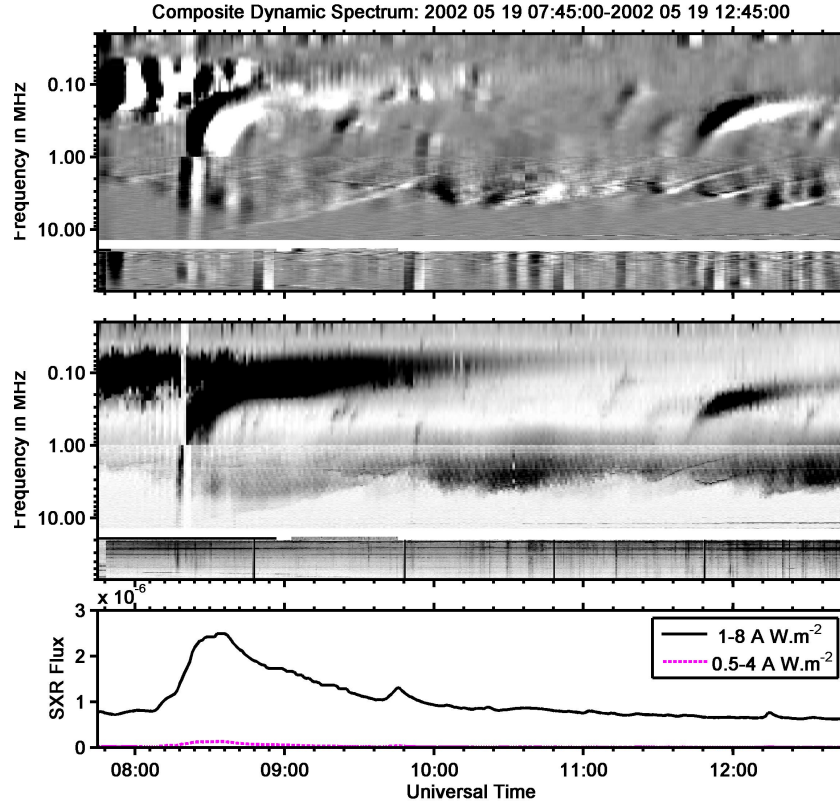
**Figure 5.** 18-22 May 2002 event from 18:08:00 UT to 24:03:00 UT. Top panel: *Wind*/WAVES differential spectrum (inverse grey scale). Middle Panel: Dynamic (intensity, inverse grey scale) spectrum. The frequency-time plots derived from the linear fits to the front trajectory of the associated CMEs and the density model presented in Section 3.2 for the fundamental and harmonic (dashed curves) plasma emission are overlaid on the spectra. In this case the CME trajectories are of different colors. Bottom Panel: The profiles of GOES SXR 1-8 Å (solid-black line) and 0.4-4 Å (dashed-red line) flux. The time is written in the format date, hours, and minutes.

appearing on the NE quadrant over the AR 9957, AR 9958, AR 9960, AR 9962, AR 9963 group during the 19–23 May period. The metric and decametric continuum appears on the SW quadrant, over AR 9948, only on 18 May (see Figure 8); on this day it coexists with the persistent continuum (over the AR 9957) mentioned above.

The SXR activity originates, mostly, in the NE (AR 9957, AR 9958, AR 9960, AR 9962, AR 9963 group) and the SE (AR 9961) quadrants; most of the CME position angles indicate ejections from the same two quadrants (see Figure 7, right panel). The position of the type III bursts, which could be localized, were almost equally divided between the SE and the NE quadrants but the vast majority appears clearly on the differential spectra to continue into the *Wind*/WAVES hectometric range at frequencies lower than the type IV<sub>IP</sub>. Furthermore the type III and CME activity continues past the end of the interplanetary type IV burst. The metric continuum, on the other hand, appears persistently, in the NRH images, on top of the AR 9957, AR 9958, AR 9960, AR 9962, AR 9963 group from the 19 to the 23 May. This implies a steady coronal reservoir of energetic electrons, which may follow the magnetic lines trailing CMEs originating at the NE quadrant and replenish the electrons of the interplanetary type IV<sub>IP</sub> burst.

### 3.5. Overview of the 27–28 May 1999 Extended Event Evolution

The event starts on 27 May 1999 at 10:55 UT and ends on 28 May at 15:00 UT (catalogue number 45). The event is composed by interplanetary type II/IV

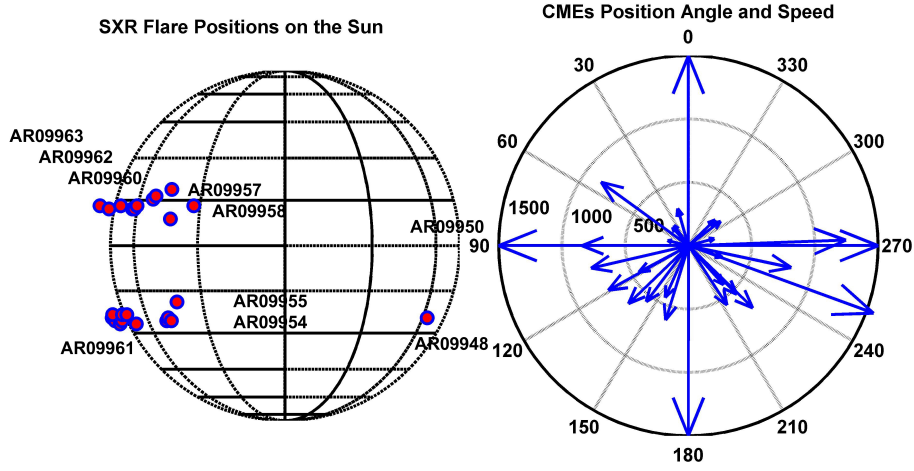


**Figure 6.** 18–22 May 2002 event with details on 19 May from 07:45 UT to 12:45 UT. The dynamic spectra are combined records from *Wind*/WAVES, DAM and extended in the 0.02–70 MHz range. Top pannel: Differential spectrum (inverse grey scale). Middle Panel: Dynamic (intensity, inverse grey scale) spectrum. Bottom Panel: The profiles of GOES SXR 1–8 Å (solid-black line) and 0.4–4 Å (dashed-red line) flux

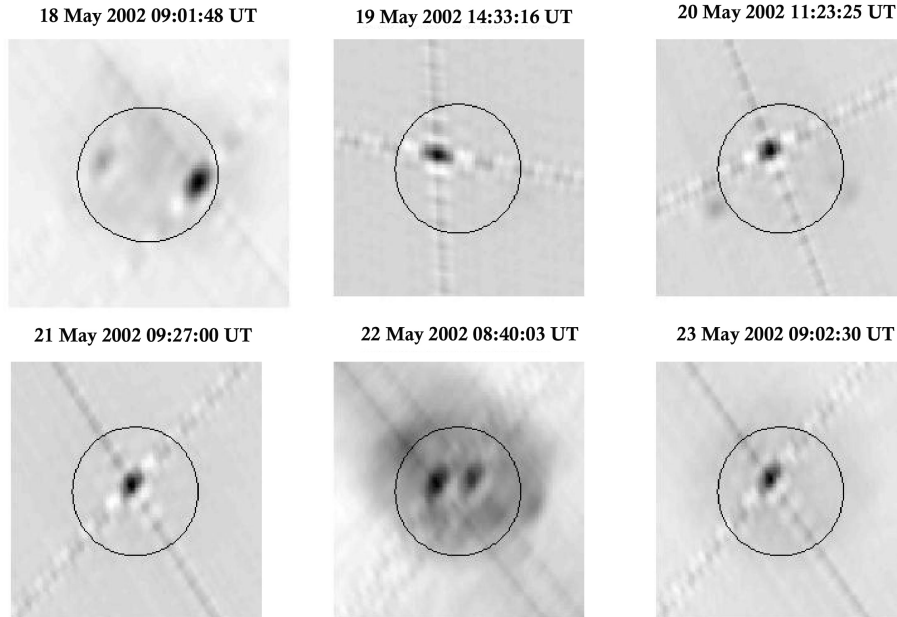
bursts where both have coronal extensions. This event is accompanied by a number of C-class SXR flares and narrow CMEs. An overview including *Wind*/WAVES dynamic spectrum, the CME front trajectories, and the SXR flux profiles is presented in Figure 9. There are only two wide CMEs, a halo on 27 May at 11:06 UT and a rather wide CME on 28 May at 10:26 UT, which almost mark the start and the end of the event.

Similar to the 18–22 May 2002 event, in Section (3.4), there is also a persistent coronal type IV, which appears over AR 8552 (N18E31) on the NRH records. This region remains active throughout the duration of the interplanetary type IV burst and most of the small SXR flares and a number of type III bursts originate from it as well. In Figure 12 we present the position of the coronal type IV, on 27 and 28 May, in the form of NRH images. There is also a long series of type III bursts and groups, which covers the type IV<sub>IP</sub> interval. Most of these type III bursts, however, overshoot the type IV<sub>IP</sub> continuum so we expect that the main source of energetic electrons is its coronal counterpart persisting over AR8552.

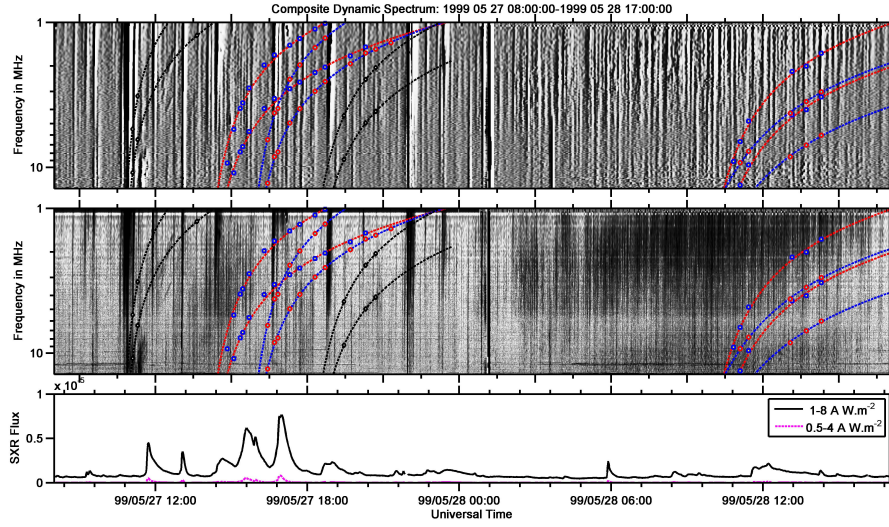




**Figure 7.** Left: Positions of the SXR flares (purple dots with blue border) and active-regions. Right: CME position angles and CME speeds indicated with segments ending in an arrow-head. The segment length is proportional to the CME speed. The active region positions are taken from the Solar Monitor ([www.solarmonitor.org](http://www.solarmonitor.org)). The flare and CME positions extend in the whole 18–23 May 2002 period; the AR positions are from the middle of this period on 20 May.



**Figure 8.** Positions of the coronal type IV bursts in the 18–22 May 2002 period, obtained by the *Nançay Radioheliograph* at 164 MHz.



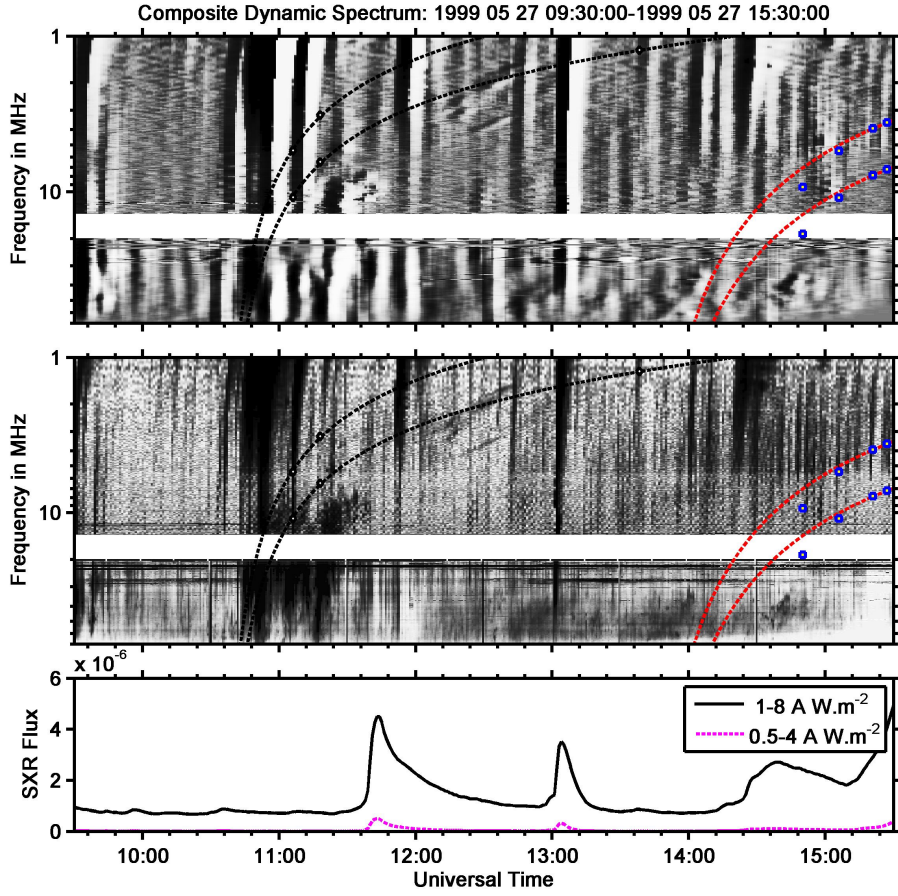
**Figure 9.** 27–28 May 1999 event in the period from 27 May 08:00 UT to 28 May 17:00 UT. Top panel: *Wind*/WAVES differential spectrum (inverse gray scale). Middle Panel: Dynamic (intensity) spectrum. The frequency-time plots derived from the linear fits to the front trajectory of the associated CME and an empirical density model (see Section 3.2) for the fundamental and harmonic (dashed curves) plasma emission are overlaid on the spectra. Bottom Panel: The profiles of GOES SXR 1–8 Å (solid-black line) and 0.4–4 Å (dashed-red line) flux. The time is in the format date hour and minutes.

The end of the 27–28 May 1999 event coincides with the wide CME mentioned at the beginning of the paragraph.

### 3.6. Overview of the 17 January 2005 Extended Event Evolution

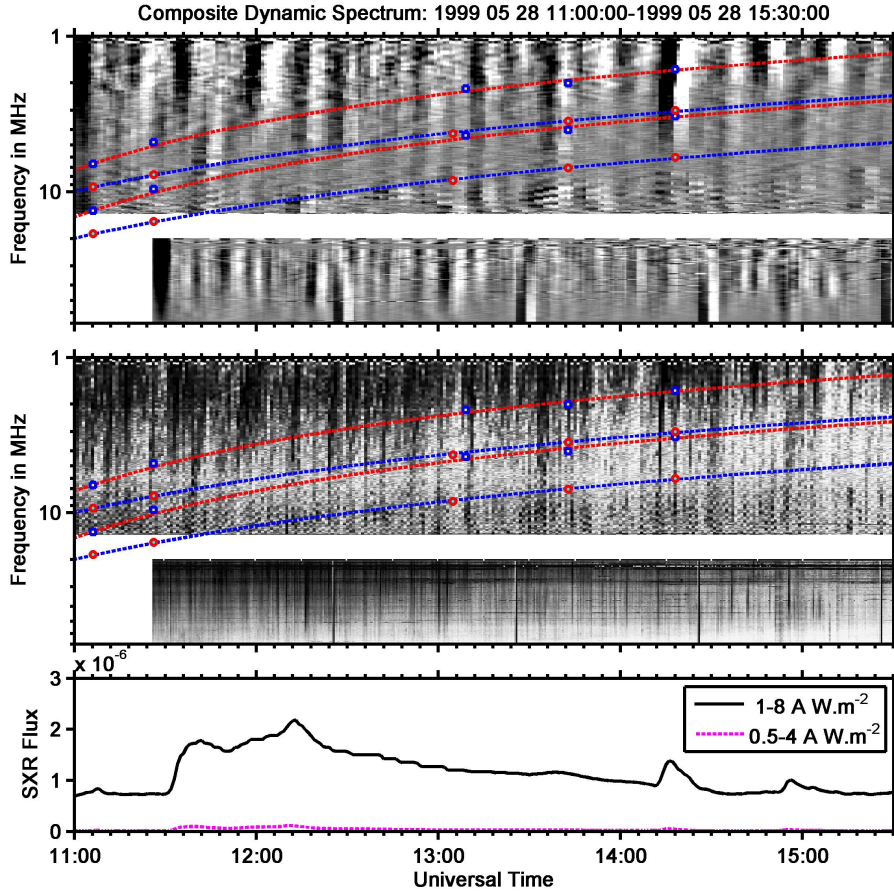
On 17 January 2005 two fast CMEs were recorded in close succession during two distinct episodes of a 3B/X3.8 flare from the AR 10720. The type IV<sub>IP</sub> burst started at 10:55 UT on 17 January and ended by 18 January at 02:00 UT (event catalog number 14), for an overview of the dynamic spectrum see Figure 3 of Hillaris *et al.* (2011). The coronal extension of the type IV<sub>IP</sub> burst was found to originate from AR10720 and persisted throughout the duration of its interplanetary counterpart. The type II activity, on the other hand, was restricted to the frequency range below 14 MHz. The type III groups accompanying the event were found to overshoot the low frequency limit of the type IV<sub>IP</sub> burst at least after 08:18 UT. Earlier, groups of type U bursts and type IV fine structures indicated acceleration and partial trapping of electrons behind the CME front.

A detailed study of the radio signatures of this event (Table 1 in Hillaris *et al.*, 2011, that presents a comprehensive outline of its time evolution) points towards possible multiple acceleration mechanisms. These include CME associated shocks in the high corona and the interplanetary space, and also, shock-independent accelerators at low altitudes associated with the type IV continuum behind the CME.



**Figure 10.** 27–28 1999 event. The panels show the event in the 27 May 09:30–15:30 UT period. The dynamic spectra are combined records from the *Wind*/WAVES and the DAM in the 1–70 MHz range. This section of the type IV<sub>IP</sub> starts above 70 MHz and extends to 1 MHz. Top panel: differential spectrum (inverse gray scale). Middle Panel: Dynamic (intensity) spectrum. The frequency-time plots from the linear fits to the front trajectory of the associated CME and the density model presented in Section 3.2) for the fundamental and harmonic (dashed curves) plasma emission are overlaid on the spectra. Bottom Panel: The profiles of GOES SXR 1–8 Å (solid-black line) and 0.4–4 Å (dashed-red line) flux.

This event had distinct features of the compact class, associated with an intense flare and two fast CMEs, yet its long duration characterizes it as extended. Similar to the previous two long duration events, the energetic electrons provided by low corona sources are well associated with the coronal type IV burst.

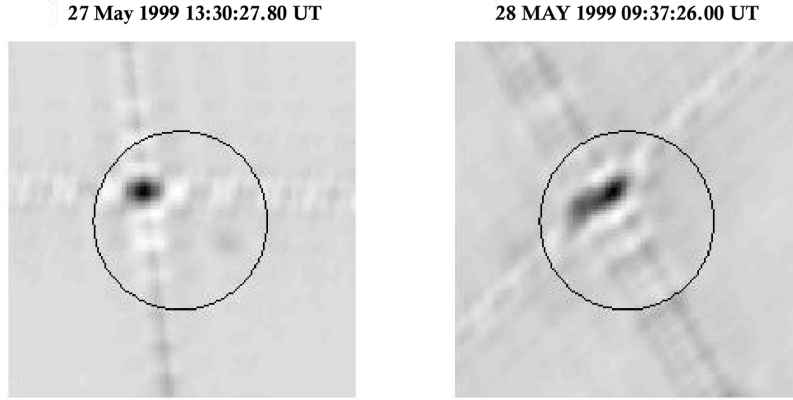


**Figure 11.** 27–28 1999 event. The panels show the event in the 27 May 11:00–15:30 period. The dynamic spectra are combined records from the *Wind*/WAVES and the DAM in the 1–70 MHz range. The type IV<sub>IP</sub> has a coronal extension above 70 MHz; the most prominent part reaches 1 MHz with some parts extending below this frequency. Top panel: differential spectrum (inverse gray scale). Middle Panel: Dynamic (intensity) spectrum. The frequency-time plots from the linear fits to the front trajectory of the associated CME and the density model presented in Section 3.2 for the fundamental and harmonic (dashed curves) plasma emission are overlaid on the spectra. Bottom Panel: The profiles of GOES SXR 1–8 Å (solid-black line) and 0.4–4 Å (dashed-red line) flux.

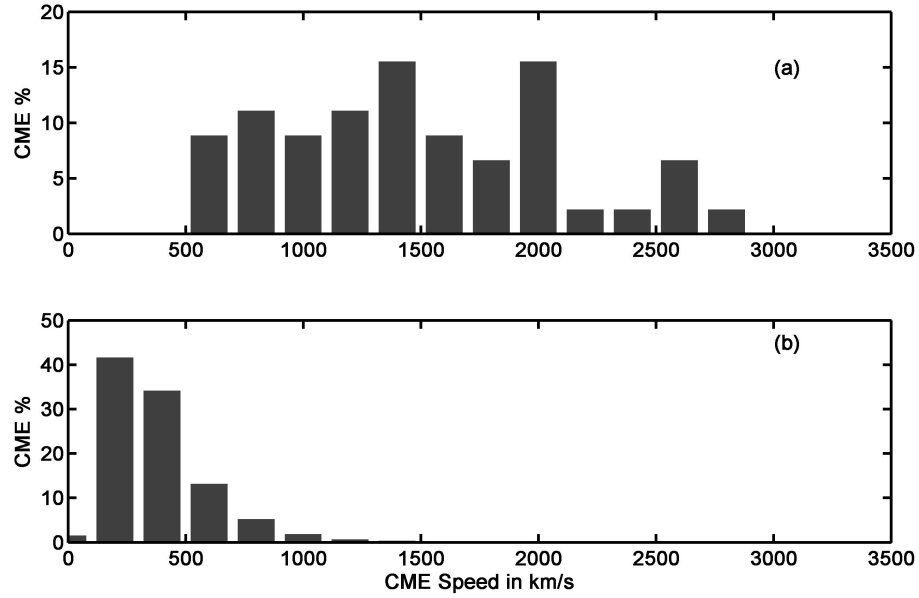
## 4. Characteristics of All Events

### 4.1. Characteristics of the 45 Compact Events

Of the 48 type IV<sub>IP</sub> bursts of our sample 45, classified as compact, were found to conform to the big flare syndrome which suggests that, statistically, energetic phenomena are more intense in larger flares, regardless of the detailed physics. In fact 19 were associated with X-class flares and 21 with M-class with only five events related to C-class flares. This represents a significant deviation with respect to the general GOES SXR flare distribution studied by Veronig *et al.*



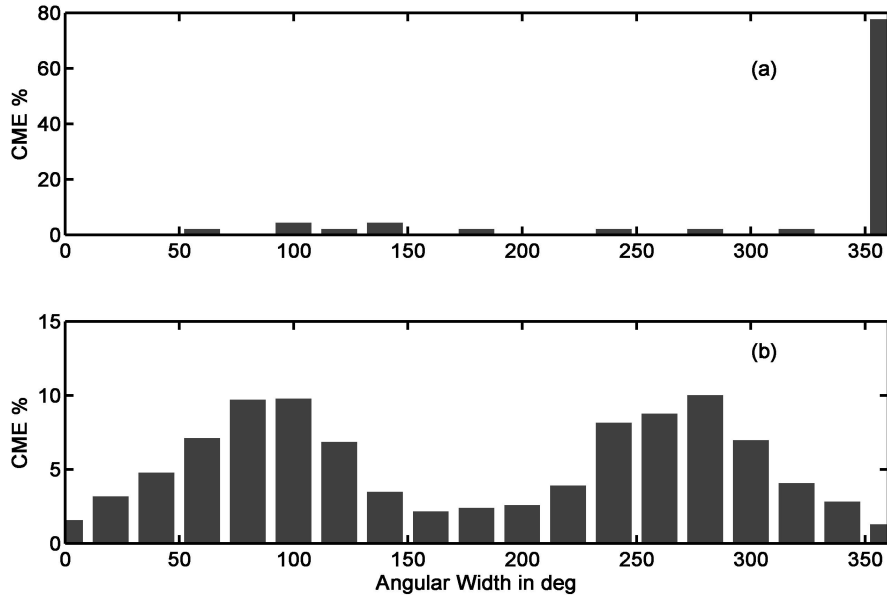
**Figure 12.** Positions of the coronal type IV bursts in the 27–28 May 1999 period, obtained by the *Nançay Radioheliograph* at 164 MHz.



**Figure 13.** Distribution (%) of CME speeds in  $\text{km s}^{-1}$ . (a) LASCO CMEs associated with compact events. (b) All LASCO CMEs in the 1998–2012 period for comparison.

(2002). In the general case it is expected that  $\sim 66\%$  of the SXR flares are of class C with  $\sim 9.5\%$  of class M and just  $\sim 0.7\%$  of class X.. The general case is, also, consistent with the power-law distribution of the peak SXR flux [I], where the probability density,  $p(I) \sim I^{-b}$  with  $b \approx 2$  (see Aschwanden and Freeland, 2012).

As regards the CME compact-event association, 32 of these events were trailing CMEs with speeds  $\sim 1400 \text{ km s}^{-1}$  on average with only 11 events having



**Figure 14.** Distribution (%) of CME widths. (a) LASCO CMEs associated with compact events. (b) All LASCO CMEs in the 1998–2012 period for comparison.

CMEs slower than  $1000 \text{ km s}^{-1}$  ( $600\text{--}900 \text{ km s}^{-1}$  range). This deviates significantly from the LASCO CME distribution from 1998 to 2011. The comparison of the distributions is presented in Figure 13. The same CMEs were found, systematically, in the  $\sim 360^\circ$  tail of the width distribution (see Figure 14). These fast and wide CMEs were expected to transport the type IV emitting energetic electrons confined within their cavities. Bain *et al.* (2014) calculated that the electrons accelerated during the CME initiation or early propagation phase, trapped in the magnetic structure of the CME, do not need to be replenished for times of the order of four hours. This is consistent with the duration of the compact type IV bursts which is, on average, about 106 minutes. Furthermore, 43 compact events were characterized by a CME preceding by some hours the associated fast CME along the same path (similar measured position angle in the LASCO CME catalog) could have reduced the propagation drag of the trailing CME.

Contrary to the discussion in the previous paragraph, during the interval from 28 October 2003 at 11:30 UT to 29 October at 10:17 UT, no CME was reported in the SOHO/LASCO catalog, yet two type IV<sub>IP</sub> bursts, in close succession, were recorded by the *Wind*/WAVES. These correspond to entries 28 and 29 in the attached online table and represent two compact events associated with M-class flares. In the column with remarks of the CME catalog, at the line corresponding to the 28 October 2003 11:30 halo CME and the associated X17.2 flare, it is noted that "*all images after 13:00 UT, particularly C3, are severely degraded due to the ongoing proton storm*". The non-detection of CMEs associated with the events on 28 and 29 May can, therefore, be due to this fact.



#### 4.2. Characteristics of the three Extended Events

As regards the three extended or long duration type IV<sub>IP</sub> events, they seem to need a resupply of the continuum as they last from 960 min to 115 hours (examples in Figures 9 and 5); this requirement holds regardless of the intensity and speed of the first associated flare/CME. Now the energetic electron sources in the corona manifest themselves as metric–decametric type III and type IV radio bursts. These electron sources need be associated with the lift off and propagation of CMEs as they deform the solar magnetic field providing a propagation path for the energetic electrons and, at the same time, a moving magnetic trap.

In the examples of extended interplanetary type IV bursts discussed in Sections 3.4, 3.5 and 3.6 we see the replenishment process, mentioned above, at work. In all cases we have, in addition to the dynamic spectra, a partial coverage with NRH images. The energetic electron sources in the corona manifesting themselves as metric and decametric type IV radio bursts persist, in the same position, for the duration of each of the interplanetary type IV bursts.

There are, however, other possible sources of energetic electrons. Firstly, the type III bursts; these appear to extend in the dynamic spectra far beyond the low frequency limits of the type IV<sub>IP</sub> bursts; therefore, a mechanism of electron deposition into the type IV<sub>IP</sub> is not easily envisaged. The type III-like activity, however, embedded within the type IV continua as part of the type IV fine structure is linked to the type IV energetic population and the corresponding acceleration process. Another kind of type III-like activity, are the micro-type III bursts which are parts of the IP storms. As they are significantly weaker than the standard type III (six orders of magnitude, see Morioka *et al.*, 2007) they are difficult to detect, especially in the presence of type IIIs but they cannot be ruled out.

Secondly, the type IV<sub>IP</sub> replenishment from the shock accelerated electrons is considered. The type II bursts appear, mostly, piston driven by CMEs and preceding the type IV continuum, interplanetary and coronal, which evolves in their wake, possibly within the CME core. This implies a sort of magnetic isolation from energetic populations in the vicinity of the CME bow shock. This been said, we note that the possibility of acceleration in the low corona by shocks distinct from those preceding the type IV cannot be precluded; the observational confirmation is difficult however as these are often buried in other types of radio activity.

#### 5. Discussion and Conclusions

The present study is based on a multi-frequency and multi-instrument study of a sample of 48 interplanetary type IV (type IV<sub>IP</sub>) bursts identified from the *Wind*/WAVES on line catalog. The dynamic spectra obtained from the *Wind*/WAVES R1 and R2 receivers, in the hectometric frequency range, were combined with metric and decametric dynamic spectra and supplemented with GOES SXR light curves and LASCO CME data.

In most cases, 45 out of 48, the extension of a metric–decametric moving type IV bursts in the hectometric frequency range was found to be associated to a fast and wide CME (see Section 4.1) capable of driving the embedded type IV source into the high corona. This type of bursts have duration of about 106 minute, on average; they were dubbed compact type IV<sub>IP</sub> bursts. The reduced aerodynamic drag in the wake of a previous CME, along the same propagation path, appears to increase the probability of the appearance of a type IV<sub>IP</sub> burst. This preconditioning of interplanetary space by a previous CME was first proposed, before the discovery of CMEs, by Caroubalos (1964) who stated that a disturbance following a preceding disturbance encounters much more regular conditions than the first. This result corresponds to the effect of CMEs on the structure of the ambient magnetic field and solar wind flow which in turn controls the propagation behavior of trailing CMEs as discussed in a number of publications (Vršnak and Žic, 2007; Gopalswamy, 2008; Baker *et al.*, 2013; Vršnak *et al.*, 2014; Liu *et al.*, 2014; Temmer and Nitta, 2015). The basic argument, in all cases, is that a CME may be subject to a minimal slow down in the wake of a preceding CME, as it encounters a preconditioned region of depleted ambient plasma density and almost radial magnetic field lines; within this region a reduced aerodynamic drag is expected. The efficiency of this effect increases, possibly, if the main CME is quite dense (as discussed by Temmer and Nitta, 2015, based on detailed modelling of a CME propagation). It is also expected that a wide preceding CME would result in a greater drop of the aerodynamic drag compared to a narrow CME along the path of the main CME. Further complications may arise due to more than one CME, preceding the main CME, to the projection effects as regards CME paths and speeds and the ambiguities in CME mass calculations. Despite these, this report provides qualitative support to the reduced aerodynamic drag due to preconditioning hypothesis.

Apart from the preconditioning of space by a preceding CME, discussed in the previous paragraph, the characteristics of these events were consistent with the big flare syndrome since they were mostly associated with medium to large flares and fast CMEs (see Section 4.1). As regards the small number (five of 45) of events associated with smaller flares we found that either the type IV burst was originating at the solar limb (numbers 37 and 44 in the attached table) or (numbers 35, 42, and 43) the origin of the flare was not known; in both cases the flare association was quite uncertain. There were also intense flares within the period of interest, 1998–2012, which did not give type IV<sub>IP</sub> bursts. This may be interpreted, at least in part, by the fact that in the *Wind*/WAVES catalog some are not listed as type IV bursts. On 20 January 2005, for example the interplanetary radio signature of the X7.1/2B flare accompanied by a fast ( $\approx 900$  km s<sup>-1</sup>) halo CME was described as very diffuse. The same holds for the major solar eruption of 7 March 2012 (X5.4 and X1.3 flares associated with two fast ( $> 2000$  km s<sup>-1</sup>) CMEs, see Patsourakos *et al.*, 2013, 2016); this is mentioned as strong intermittent multiple tones.

In the three long duration, or extended, type IV<sub>IP</sub> bursts, the energetic electron population, which is the type IV<sub>IP</sub> source, seems to be replenished from the lower solar corona. This implies the possibility of a connection of the type



$IV_{IP}$  enclosing magnetic structure to low coronal electron accelerators or coronal reservoirs. The NRH images, when available, indicate that these are possibly associated to the high frequency type IV which persists throughout the duration of the extended type  $IV_{IP}$  burst.

A steady coronal reservoir of energetic electrons appears to be the metric type IV continuum as most of the type IIIs tend to overshoot the interplanetary type IV. The micro-type III bursts, on the other hand, may trace the electrons' path from the coronal reservoir to the type  $IV_{IP}$ . We state, at this point, that the term coronal reservoir is used in order to distinguish from the heliospheric reservoirs (see Roelof *et al.*, 1992; Sarris and Malandraki, 2003) beyond 1AU. The fact that the extended type  $IV_{IP}$  bursts appear to result, cumulatively, from relatively small energetic events, suggests the presence of some type of trapping structure for the exciter energetic electrons. The type  $IV_{IP}$  heliocentric distances, however, are  $\sim 25\text{--}95R_{\odot}$  which are quite smaller than the 1AU, and beyond, distance of the heliospheric reservoirs.

The question of the confinement of the energetic electrons, producing this type of bursts, at heliocentric distances of the order of some tens of  $R_{\odot}$  remains open.

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## Disclosure of Potential Conflicts of Interest

The authors declare that they have no conflicts of interest.

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## Appendix

### Comprehensive Catalog of the Type IV<sub>IP</sub> Burst Records

In the table (Table 1), which is attached as online supplementary material, we provide a summary of the interplanetary type IV bursts recorded by the *Wind*/WAVES R1 and R2 receivers in the 13.825 MHz–20 kHz frequency range, with their associated CMEs and SXR flares in the 1998–2012 period. The coronal

extensions of these bursts by the RSTN, DAM, *ARTEMIS-IV*, CULGOORA, *Hiraiso* and IZMIRAN *Radio Spectrographs* are included for comparison.

The headline to each event includes event number, date of observation and characterization of the event as compact or extended following the classification introduced in Section 3. Column 1 gives the type of activity, for SXR flares we give the GOES class. The secondary headline, CME preceding Main Ejection, stands for CMEs preceding the main CME associated with the event by approximately two days along the same path; the path similarity is determined by the comparison of the position angle (PA) and width of the preceding CME to the main. In the Extended Events the secondary headline is sometimes absent as they may originate from a number of energetic events (flares and CMEs) and not from a powerful flare/fast CME with the latter propagating in the wake of preceding ejections (see discussion in Section 5). Columns 2-3 give start, peak, and end of each type of activity in UT and day month hour minute (DD MMM HH:MM) format for start and end. D indicates that the event extends in time beyond the observation period. The CME start time, in the second column is the first C2 appearance, while its extrapolated lift-off time appears in the next row as a remark (see below for the description of the remark lines). In the fourth column, we give the SXR flare  $1-8 \text{ \AA}$  integrated flux ( $F_{\text{SXR}}^{\text{tot}}$  in  $\text{J m}^{-2}$ ) and, in the same column, the CME speed ( $V_{\text{CME}}$ ) in  $\text{km s}^{-1}$ . The location of the flare on the disk and the CME measured position angle (MPA) of the CMEs with their angular width in parenthesis are given in the fifth column. The SXR flare location is determined from the position of the associated  $\text{H}\alpha$  flare on disk or the Solar X-ray Imager of GOES report if available. In the fifth column, we also give the position of the coronal radio bursts when NRH records are available. In the sixth column, we give the frequency range of the radio bursts in MHz; the L indicates that the burst extends to lower frequencies, H stands for high-frequency extension.

Comments and remarks, when necessary, are in separate lines under the description of the activity line. The comments include the reporting stations from which the data of each observation was obtained and the classification of the *Wind*/WAVES and the SOHO/LASCO records and the NOAA active region number of the event. For the SXR flares the SXR peak and the  $\text{H}\alpha$  category when available are reported while for the CMEs the extrapolated lift-off time is presented. Finally, in the comment lines data gaps, if any, are reported.

The reporting observatory or space experiment abbreviations used in Table 1 are:

ART-4 *ARTEMIS-IV*, Greece  
 CUL *Culgoora*, Australia  
 SAG *RSTN: Sagamore Hill*, Massachusetts, USA  
 PAL *RSTN: Palehua*, Hawaii  
 HOL *RSTN: Holloman*, New Mexico, USA  
 LEA *RSTN: Learmonth*, Australia  
 SVI *RSTN: San Vito*, Italy  
 RAM *Ramey AFB*, Puerto Rico, USA  
 IZM *The radio spectrograph of Izmiran*

KANZ *Kanzelhöhe Solar Observatory*MIT *National Astronomical Observatory of Japan, Mitaka*HiRAS *Hiraiso Radio Spectrograph*DAM *The Nançay Decameter Array*NRH *The Nançay radioheliograph*XFL SXR flare from the *GOES Solar X-ray Imager (SXI)*Gxx SXR flare from the *GOES* (for example G08 stands for GOES 08)

All abbreviations, with the exception of NRH, DAM, and ART-4, were adopted from the Space Weather Prediction Center<sup>11</sup> station list

**Table 1.:** Type IV<sub>IP</sub> Radio Bursts and Associated Activity

| Obs.                              | Start<br>Universal Time                                   | End           | $F_{\text{SXR}}^{\text{tot}}$<br>(J m <sup>-2</sup> )<br>$V_{\text{CME}}$<br>(km s <sup>-1</sup> ) | Position<br>PA - Width | Freq.<br>MHz |
|-----------------------------------|-----------------------------------------------------------|---------------|----------------------------------------------------------------------------------------------------|------------------------|--------------|
| Compact Event: 01 - 05 March 2012 |                                                           |               |                                                                                                    |                        |              |
| Type IV                           | 05 Mar. 04:15                                             | 05 Mar. 07:00 |                                                                                                    |                        | 14 - 7.0     |
| Type II                           | 05 Mar. 04:00                                             | 05 Mar. 12:20 |                                                                                                    |                        | 14 - 0.4     |
|                                   | Type IV <sub>IP</sub> and II (F-H), by <i>Wind</i> /WAVES |               |                                                                                                    |                        |              |
| Type IV                           | 05 Mar. 03:33                                             | 05 Mar. 08:33 |                                                                                                    |                        | 25L - 500H   |
|                                   | Coronal Type IV by LEA, HiRAS                             |               |                                                                                                    |                        |              |
| Type III                          | 05 Mar. 03:33                                             | 05 Mar. 04:48 |                                                                                                    |                        | 500 - 1.0L   |
|                                   | Two Groups (GG) by <i>Wind</i> /WAVES, HiRAS and LEA      |               |                                                                                                    |                        |              |
| X1.1                              | 05 Mar. 02:30                                             | 05 Mar. 04:43 | $3.70 \times 10^{-1}$                                                                              | N17E52                 |              |
|                                   | Peak at 04:09, 2B, in AR11429 by G15 and LEA              |               |                                                                                                    |                        |              |
| CME                               | 05 Mar. 04:00                                             |               | 1531                                                                                               | 61° - halo             |              |
|                                   | CME Lift-off: 05 Mar. 03:31                               |               |                                                                                                    |                        |              |
| CME(s)Preceding Main Ejection     |                                                           |               |                                                                                                    |                        |              |
| CME                               | 05 Mar. 03:12                                             |               | 594                                                                                                | 46° (92°)              |              |
| CME                               | 04 Mar. 20:48                                             |               | 720                                                                                                | 52° (65°)              |              |
| CME                               | 04 Mar. 11:00                                             |               | 1306                                                                                               | 52° - halo             |              |

<sup>11</sup><ftp.swpc.noaa.gov/pub/welcome/stations>

Table 1.: Type IV<sub>IP</sub> Radio Bursts and Associated Activity-Continued

| Obs.                                                                    | Start<br>Universal Time | End           | $F_{\text{SXR}}^{\text{tot}}$<br>(J m <sup>-2</sup> )<br>$V_{\text{CME}}$<br>(km s <sup>-1</sup> ) | Position<br>PA - Width | Freq.<br>MHz |
|-------------------------------------------------------------------------|-------------------------|---------------|----------------------------------------------------------------------------------------------------|------------------------|--------------|
| Compact Event: 02 - 04 March 2012                                       |                         |               |                                                                                                    |                        |              |
| Type IV                                                                 | 04 Mar. 11:15           | 04 Mar. 12:15 |                                                                                                    |                        | 14 - 8.0     |
| Type II                                                                 | 04 Mar. 12:15           | 04 Mar. 17:00 |                                                                                                    |                        | 0.9 - 0.3    |
| Type IV <sub>IP</sub> and II, by <i>Wind</i> /WAVES                     |                         |               |                                                                                                    |                        |              |
| Type IV                                                                 | 04 Mar. 10:00           | 04 Mar. 12:15 |                                                                                                    | N19E61                 | 550H - 20L   |
| Coronal Type IV by ART-IV, NRH and SVI                                  |                         |               |                                                                                                    |                        |              |
| Type III                                                                | 04 Mar. 10:58           | 04 Mar. 11:43 |                                                                                                    |                        | 500 - 1.0L   |
| Group (GG) by <i>Wind</i> /WAVES, ART-IV, NRH and SVI                   |                         |               |                                                                                                    |                        |              |
| M2.0                                                                    | 04 Mar. 10:29           | 04 Mar. 12:16 | $9.20 \times 10^{-2}$                                                                              | N19E61                 |              |
| Peak at 10:52, 1N, in AR11429 by G15 and SVI                            |                         |               |                                                                                                    |                        |              |
| CME                                                                     | 04 Mar. 11:00           |               | 1306                                                                                               | 52° - halo             |              |
| CME Lift-off: 04 Mar. 10:31                                             |                         |               |                                                                                                    |                        |              |
| CME(s) Preceding Main Ejection                                          |                         |               |                                                                                                    |                        |              |
| CME                                                                     | 04 Mar. 05:00           |               | 584                                                                                                | 52° (160°)             |              |
| Partial halo CME                                                        |                         |               |                                                                                                    |                        |              |
| Compact Event: 03 - 27 January 2012                                     |                         |               |                                                                                                    |                        |              |
| Type II                                                                 | 27 Jan. 18:30           | 28 Jan. 04:45 |                                                                                                    |                        | 14 - 0.150   |
| Type IV                                                                 | 27 Jan. 18:45           | 27 Jan. 20:20 |                                                                                                    |                        | 14 - 10      |
| Type IV <sub>IP</sub> and II (F-H, intermittent), by <i>Wind</i> /WAVES |                         |               |                                                                                                    |                        |              |
| Type II                                                                 | 27 Jan. 18:13           | 27 Jan. 18:25 |                                                                                                    |                        | 25L - 75     |
| Type IV                                                                 | 27 Jan. 18:14           | 27 Jan. 18:44 |                                                                                                    |                        | 25L - 180H   |
| Coronal Type II and IV by SAG                                           |                         |               |                                                                                                    |                        |              |
| Type III                                                                | 27 Jan. 17:37           | 27 Jan. 18:31 |                                                                                                    |                        | 180H - 1.0L  |
| Group (GG) by <i>Wind</i> /WAVES, and SAG                               |                         |               |                                                                                                    |                        |              |
| X1.7                                                                    | 27 Jan. 17:37           | 27 Jan. 18:56 | $3.20 \times 10^{-1}$                                                                              | N27W71                 |              |
| Peak at 18:37, 1F, in AR11402 by G15 and HOL                            |                         |               |                                                                                                    |                        |              |
| CME                                                                     | 27 Jan. 18:28           |               | 2508                                                                                               | 296° - halo            |              |
| CME Lift-off: 27 Jan. 18:14                                             |                         |               |                                                                                                    |                        |              |
| CME(s) Preceding Main Ejection                                          |                         |               |                                                                                                    |                        |              |
| CME                                                                     | 27 Jan. 03:47           |               | 415                                                                                                | 230° (92°)             |              |
| CME                                                                     | 26 Jan. 04:36           |               | 1194                                                                                               | 327° - halo            |              |

| Table 1.:Type IV <sub>IP</sub> Radio Bursts and Associated Activity-Continued |                         |                                                                      |                                                                                                    |                        |              |
|-------------------------------------------------------------------------------|-------------------------|----------------------------------------------------------------------|----------------------------------------------------------------------------------------------------|------------------------|--------------|
| Obs.                                                                          | Start<br>Universal Time | End                                                                  | $F_{\text{SXR}}^{\text{tot}}$<br>(J m <sup>-2</sup> )<br>$V_{\text{CME}}$<br>(km s <sup>-1</sup> ) | Position<br>PA - Width | Freq.<br>MHz |
| Compact Event: 04 - 24 September 2011                                         |                         |                                                                      |                                                                                                    |                        |              |
| Type IV                                                                       | 24 Sep. 19:45           | 24 Sep. 21:15                                                        |                                                                                                    |                        | 14 - 7.0     |
|                                                                               |                         | Type IV <sub>IP</sub> by <i>Wind</i> /WAVES                          |                                                                                                    |                        |              |
| Type IV                                                                       | 24 Sep. 18:30           | 24 Sep. 20:30                                                        |                                                                                                    |                        | 180H - 25L   |
|                                                                               |                         | Coronal Type IV by LEA                                               |                                                                                                    |                        |              |
| Type III                                                                      | 24 Sep. 19:09           | 24 Sep. 21:05                                                        |                                                                                                    |                        | 180H - 1.0L  |
|                                                                               |                         | Four Groups (GG) by <i>Wind</i> /WAVES, and LEA                      |                                                                                                    |                        |              |
| M3.0                                                                          | 24 Sep. 19:09           | 24 Sep. 19:41                                                        | $4.60 \times 10^{-2}$                                                                              | N15E56                 |              |
|                                                                               |                         | Peak at 19:21, in AR11302 by G15                                     |                                                                                                    |                        |              |
| CME                                                                           | 24 Sep. 19:36           |                                                                      | 972                                                                                                | 43° - halo             |              |
|                                                                               |                         | CME Lift-off: 24 Sep. 18:55                                          |                                                                                                    |                        |              |
| CME(s)Preceding Main Ejection                                                 |                         |                                                                      |                                                                                                    |                        |              |
| CME                                                                           | 24 Sep. 12:48           |                                                                      | 1915                                                                                               | 78° - halo             |              |
| Compact Event: 05 - 24 September 2011                                         |                         |                                                                      |                                                                                                    |                        |              |
| Type IV                                                                       | 24 Sep. 13:00           | 24 Sep. 14:15                                                        |                                                                                                    |                        | 14 - 8.0     |
| Type II                                                                       | 24 Sep. 12:50           | 24 Sep. 22:45                                                        |                                                                                                    |                        | 14 - 0.3     |
|                                                                               |                         | Type IV <sub>IP</sub> and II (Multiple tones), by <i>Wind</i> /WAVES |                                                                                                    |                        |              |
| Type IV                                                                       | 24 Sep. 12:30           | 24 Sep. 15:00D                                                       |                                                                                                    | N15E56                 | 200 - 20L    |
|                                                                               |                         | Coronal Type IV by ART-IV, DAM and NRH                               |                                                                                                    |                        |              |
| Type III                                                                      | 24 Sep. 12:30           | 24 Sep. 13:26                                                        |                                                                                                    |                        | 200H - 1.0L  |
|                                                                               |                         | by <i>Wind</i> /WAVES, ART-IV, DAM and NRH                           |                                                                                                    |                        |              |
| M7.1                                                                          | 24 Sep. 12:33           | 24 Sep. 14:10                                                        | $2.90 \times 10^{-1}$                                                                              | N15E56                 |              |
|                                                                               |                         | Peak at 13:20, 1B, in AR11302 by G15 and HOL                         |                                                                                                    |                        |              |
| CME                                                                           | 24 Sep. 12:48           |                                                                      | 1915                                                                                               | 78° - halo             |              |
|                                                                               |                         | CME Lift-off: 24 Sep. 12:33                                          |                                                                                                    |                        |              |
| CME(s)Preceding Main Ejection                                                 |                         |                                                                      |                                                                                                    |                        |              |
| CME                                                                           | 24 Sep. 09:48           |                                                                      | 1936                                                                                               | 90° (145°)             |              |

Table 1.: Type IV<sub>IP</sub> Radio Bursts and Associated Activity-Continued

| Obs.                                                                 | Start<br>Universal Time | End           | $F_{\text{SXR}}^{\text{tot}}$<br>(J m <sup>-2</sup> )<br>$V_{\text{CME}}$<br>(km s <sup>-1</sup> ) | Position<br>PA - Width | Freq.<br>MHz |
|----------------------------------------------------------------------|-------------------------|---------------|----------------------------------------------------------------------------------------------------|------------------------|--------------|
| Compact Event: 06 - 22 September 2011                                |                         |               |                                                                                                    |                        |              |
| Type IV                                                              | 22 Sep. 11:15           | 22 Sep. 12:30 |                                                                                                    |                        | 14 - 10      |
| Type II                                                              | 22 Sep. 11:05           | 22 Sep. 24:00 |                                                                                                    |                        | 14 - 0.07    |
| Type IV <sub>IP</sub> and II (Multiple tones), by <i>Wind</i> /WAVES |                         |               |                                                                                                    |                        |              |
| Type IV                                                              | 22 Sep. 10:38           | 22 Sep. 14:00 |                                                                                                    | N13E78                 | 180H - 25L   |
| Type II                                                              | 22 Sep. 10:38           | 22 Sep. 10:45 |                                                                                                    |                        | 100H - 25L   |
| Coronal Type IV and II by ART-IV, SVI and NRH                        |                         |               |                                                                                                    |                        |              |
| Type III                                                             | 22 Sep. 10:38           | 22 Sep. 11:20 |                                                                                                    |                        | 180H - 1.0L  |
| Two Groups (GG) by <i>Wind</i> /WAVES, ART-IV, SVI and NRH           |                         |               |                                                                                                    |                        |              |
| X1.4                                                                 | 22 Sep. 10:29           | 22 Sep. 11:44 | $4.50 \times 10^{-1}$                                                                              | N13E78                 |              |
| Peak at 11:01, 2N, in AR11302 by G15 and SVI                         |                         |               |                                                                                                    |                        |              |
| CME                                                                  | 22 Sep. 10:48           |               | 1905                                                                                               | 72° - halo             |              |
| CME Lift-off: 22 Sep. 10:28                                          |                         |               |                                                                                                    |                        |              |
| CME(s)Preceding Main Ejection                                        |                         |               |                                                                                                    |                        |              |
| CME                                                                  | 21 Sep. 22:12           |               | 1007                                                                                               | 305°(>255°)            |              |
| Uncertain Width, Partial halo.                                       |                         |               |                                                                                                    |                        |              |
| CME                                                                  | 21 Sep. 10:12           |               | 229                                                                                                | 50°(74°)               |              |
| CME                                                                  | 21 Sep. 04:36           |               | 290                                                                                                | 71°(73°)               |              |
| Two PoorEvents                                                       |                         |               |                                                                                                    |                        |              |
| Compact Event: 07 - 14 December 2006                                 |                         |               |                                                                                                    |                        |              |
| Type II                                                              | 14 Dec. 22:30           | 14 Dec. 23:40 |                                                                                                    |                        | 14 - 1.5     |
| Type IV                                                              | 14 Dec. 22:30           | 14 Dec. 23:45 |                                                                                                    |                        | 14 - 5.0     |
| Type IV <sub>IP</sub> and II, by <i>Wind</i> /WAVES                  |                         |               |                                                                                                    |                        |              |
| Type II                                                              | 14 Dec. 22:06           | 14 Dec. 22:18 |                                                                                                    |                        | 200H - 18L   |
| Type IV                                                              | 14 Dec. 22:06           | 14 Dec. 23:30 |                                                                                                    |                        | 500H - 18L   |
| Coronal Type IV(F-H) and II by CUL and HiRAS                         |                         |               |                                                                                                    |                        |              |
| Type III                                                             | 14 Dec. 22:06           | 14 Dec. 23:37 |                                                                                                    |                        | 300 - 1.0L   |
| Group (GG) by <i>Wind</i> /WAVES, CUL and HiRAS                      |                         |               |                                                                                                    |                        |              |
| X1.5                                                                 | 14 Dec. 21:07           | 14 Dec. 22:26 | $1.20 \times 10^{-1}$                                                                              | S06W46                 |              |
| Peak at 22:15, in AR10930 by G12 and XFL                             |                         |               |                                                                                                    |                        |              |
| CME                                                                  | 14 Dec. 22:30           |               | 1042                                                                                               | 248° - halo            |              |
| CME Lift-off: 14 Dec. 21:49                                          |                         |               |                                                                                                    |                        |              |
| CME(s)Preceding Main Ejection                                        |                         |               |                                                                                                    |                        |              |
| CME                                                                  | 13 Dec. 23:48           |               | 388                                                                                                | 237°(40°)              |              |
| CME                                                                  | 13 Dec. 02:54           |               | 1774                                                                                               | 193° - halo            |              |



| Table 1.:Type IV <sub>IP</sub> Radio Bursts and Associated Activity-Continued |                         |               |                                                                                                    |                        |              |
|-------------------------------------------------------------------------------|-------------------------|---------------|----------------------------------------------------------------------------------------------------|------------------------|--------------|
| Obs.                                                                          | Start<br>Universal Time | End           | $F_{\text{SXR}}^{\text{tot}}$<br>(J m <sup>-2</sup> )<br>$V_{\text{CME}}$<br>(km s <sup>-1</sup> ) | Position<br>PA - Width | Freq.<br>MHz |
| Compact Event: 08 - 13 December 2006                                          |                         |               |                                                                                                    |                        |              |
| Type II                                                                       | 13 Dec. 02:45           | 13 Dec. 10:40 |                                                                                                    |                        | 12 - 0.150   |
| Type IV                                                                       | 13 Dec. 03:00           | 13 Dec. 04:15 |                                                                                                    |                        | 14 - 7.0     |
| Type IV <sub>IP</sub> and II (Fast F-H), by <i>Wind</i> /WAVES                |                         |               |                                                                                                    |                        |              |
| Type II                                                                       | 13 Dec. 02:25           | 13 Dec. 02:44 |                                                                                                    |                        | 300 - 20     |
| Type IV                                                                       | 13 Dec. 02:25           | 13 Dec. 10:00 |                                                                                                    |                        | 600H - 20L   |
| Coronal Type IV and II by CUL, LEA and HiRAS                                  |                         |               |                                                                                                    |                        |              |
| Type III                                                                      | 13 Dec. 02:33           | 13 Dec. 04:07 |                                                                                                    |                        | 600H - 1.0L  |
| Several Groups (GG) by <i>Wind</i> /WAVES, CUL, LEA and HiRAS                 |                         |               |                                                                                                    |                        |              |
| X3.4                                                                          | 13 Dec. 02:14           | 13 Dec. 02:57 | $5.10 \times 10^{-1}$                                                                              | S06W23                 |              |
| Peak at 02:40, 4B, in AR10930 by G12, XFL and LEA                             |                         |               |                                                                                                    |                        |              |
| CME                                                                           | 13 Dec. 02:40           |               | 1774                                                                                               | 193° - halo            |              |
| CME Lift-off: 13 Dec. 02:19                                                   |                         |               |                                                                                                    |                        |              |
| CME(s)Preceding Main Ejection                                                 |                         |               |                                                                                                    |                        |              |
| CME                                                                           | 12 Dec. 21:47           |               | 146                                                                                                | 207°(75°)              |              |
| CME                                                                           | 12 Dec. 20:28           |               | 474                                                                                                | 198°(50°)              |              |
| Compact Event: 09 - 13 September 2005                                         |                         |               |                                                                                                    |                        |              |
| Type IV                                                                       | 13 Sep. 20:05           | 13 Sep. 21:00 |                                                                                                    |                        | 14 - 3.0     |
| Type II                                                                       | 13 Sep. 20:20           | 15 Sep. 06:00 |                                                                                                    |                        | 1.1 - 0.035  |
| Type IV <sub>IP</sub> and II, by <i>Wind</i> /WAVES                           |                         |               |                                                                                                    |                        |              |
| Type IV                                                                       | 13 Sep. 19:44           | 13 Sep. 22:00 |                                                                                                    |                        | 180H - 25L   |
| Type II                                                                       | 13 Sep. 19:45           | 13 Sep. 20:20 |                                                                                                    |                        | 80 - 25L     |
| Coronal Type IV and II by PAL and SAG                                         |                         |               |                                                                                                    |                        |              |
| Type III                                                                      | 13 Sep. 19:40           | 13 Sep. 20:09 |                                                                                                    |                        | 180H - 1.0L  |
| Two Groups (GG) by <i>Wind</i> /WAVES, PAL and SAG                            |                         |               |                                                                                                    |                        |              |
| X1.5                                                                          | 13 Sep. 19:19           | 13 Sep. 20:57 | $5.50 \times 10^{-1}$                                                                              | S09E10                 |              |
| Peak at 19:27 (Second Peak at 20:05), 2B,<br>in AR10808 by G12 and HOL        |                         |               |                                                                                                    |                        |              |
| CME                                                                           | 13 Sep. 20:00           |               | 1866                                                                                               | 149° - halo            |              |
| CME Lift-off: 13 Sep. 19:35                                                   |                         |               |                                                                                                    |                        |              |
| CME(s)Preceding Main Ejection                                                 |                         |               |                                                                                                    |                        |              |
| CME                                                                           | 12 Sep. 09:12           |               | 511                                                                                                | 135°(22°)              |              |
| CME                                                                           | 11 Sep. 13:01           |               | 1922                                                                                               | 125° - halo            |              |

Table 1.: Type IV<sub>IP</sub> Radio Bursts and Associated Activity-Continued

| Obs.                                | Start<br>Universal Time                                                          | End            | $F_{\text{SXR}}^{\text{tot}}$<br>(J m <sup>-2</sup> )<br>$V_{\text{CME}}$<br>(km s <sup>-1</sup> ) | Position<br>PA - Width | Freq.<br>MHz |
|-------------------------------------|----------------------------------------------------------------------------------|----------------|----------------------------------------------------------------------------------------------------|------------------------|--------------|
| Compact Event: 10-09 September 2005 |                                                                                  |                |                                                                                                    |                        |              |
| Type IV                             | 09 Sep. 20:15                                                                    | 09 Sep. 21:10  |                                                                                                    |                        | 14-5.0       |
| Type II                             | 09 Sep. 19:45                                                                    | 09 Sep. 22:00  |                                                                                                    |                        | 10-0.05      |
|                                     | Type II (diffuse) and IV <sub>IP</sub> by <i>Wind</i> /WAVES                     |                |                                                                                                    |                        |              |
| Type IV                             | 09 Sep. 19:34                                                                    | 09 Sep. 21:23  |                                                                                                    |                        | 180H-25L     |
| Type II                             | 09 Sep. 19:34                                                                    | 09 Sep. 19:49  |                                                                                                    |                        | 180-25L      |
|                                     | Coronal Type IV and II by PAL and HOL                                            |                |                                                                                                    |                        |              |
| Type III                            | 09 Sep. 19:30                                                                    | 09 Sep. 20:17  |                                                                                                    |                        | 180H-1.0L    |
|                                     | Group (GG) by <i>Wind</i> /WAVES, PAL and HOL                                    |                |                                                                                                    |                        |              |
| X6.2                                | 09 Sep. 19:13                                                                    | 09 Sep. 20:36  | 1.70                                                                                               | S12E58                 |              |
|                                     | Peak at 20:04, 2B, in AR10808 by G12, XFL and HOL                                |                |                                                                                                    |                        |              |
| CME                                 | 09 Sep. 19:48                                                                    |                | 2257                                                                                               | 115° - halo            |              |
|                                     | CME Lift-off: 09 Sep. 19:30                                                      |                |                                                                                                    |                        |              |
| CME(s)Preceding Main Ejection       |                                                                                  |                |                                                                                                    |                        |              |
| CME                                 | 07 Sep. 05:48                                                                    |                | 195                                                                                                | 85°(74°)               |              |
| Compact Event: 11-22 August 2005    |                                                                                  |                |                                                                                                    |                        |              |
| Type IV                             | 22 Aug. 01:45                                                                    | 22 Aug. 03:15  |                                                                                                    |                        | 14-10        |
| Type II                             | 22 Aug. 01:30                                                                    | 22 Aug. 03:35  |                                                                                                    |                        | 8-0.550      |
|                                     | Type II (Strong F, weak H) and Type IV <sub>IP</sub> Weak, by <i>Wind</i> /WAVES |                |                                                                                                    |                        |              |
| Type IV                             | 22 Aug. 00:59                                                                    | 22 Aug. 04:00D |                                                                                                    |                        | 500H-20L     |
| Type II                             | 22 Aug. 01:00                                                                    | 22 Aug. 01:45  |                                                                                                    |                        | 200-20L      |
|                                     | Coronal Type II and IV, by CUL and HiRAS                                         |                |                                                                                                    |                        |              |
| Type III                            | 22 Aug. 01:01                                                                    | 22 Aug. 01:22  |                                                                                                    |                        | 100-1.0L     |
|                                     | Group (GG) by <i>Wind</i> /WAVES, CUL and HiRAS                                  |                |                                                                                                    |                        |              |
| M2.6                                | 22 Aug. 00:44                                                                    | 22 Aug. 02:18  | $9.60 \times 10^{-2}$                                                                              | S11W54                 |              |
|                                     | Peak at 01:33, 1F, in AR10798 by G12, XFL and LEA                                |                |                                                                                                    |                        |              |
| CME                                 | 22 Aug. 01:32                                                                    |                | 1194                                                                                               | 220° - halo            |              |
|                                     | CME Lift-off: 22 Aug. 0:52                                                       |                |                                                                                                    |                        |              |
| CME(s)Preceding Main Ejection       |                                                                                  |                |                                                                                                    |                        |              |
| CME                                 | 21 Aug. 12:06                                                                    |                | 287                                                                                                | 255°(61°)              |              |
|                                     | C2 Only                                                                          |                |                                                                                                    |                        |              |

| Table 1.:Type IV <sub>IP</sub> Radio Bursts and Associated Activity-Continued |                                                                              |                |                                                                                                 |                        |              |
|-------------------------------------------------------------------------------|------------------------------------------------------------------------------|----------------|-------------------------------------------------------------------------------------------------|------------------------|--------------|
| Obs.                                                                          | Start<br>Universal Time                                                      | End            | $F_{\text{SXR}}^{tot}$<br>(J m <sup>-2</sup> )<br><br>$V_{\text{CME}}$<br>(km s <sup>-1</sup> ) | Position<br>PA - Width | Freq.<br>MHz |
| Compact Event: 12- 11 May 2005                                                |                                                                              |                |                                                                                                 |                        |              |
| Type IV                                                                       | 11 May 20:05                                                                 | 11 May 20:20   |                                                                                                 |                        | 14- 8.0      |
| Type II                                                                       | 11 May 20:05                                                                 | 11 May 20:35   |                                                                                                 |                        | 14- 2.5      |
|                                                                               | Type II (F-H) and IV <sub>IP</sub> , by <i>Wind</i> /WAVES                   |                |                                                                                                 |                        |              |
| Type II                                                                       | 11 May 19:29                                                                 | 11 May 21:00   |                                                                                                 |                        | 180H- 4L     |
| Type IV                                                                       | 11 May 19:40                                                                 | 11 May 21:00D  |                                                                                                 |                        | 180H- 25L    |
|                                                                               | Coronal TypeII and IV by PAL                                                 |                |                                                                                                 |                        |              |
| Type III                                                                      | 11 May 19:30                                                                 | 11 May 19:53   |                                                                                                 |                        | 180H- 1.0L   |
|                                                                               | Two Groups (GG) by <i>Wind</i> /WAVES and PAL                                |                |                                                                                                 |                        |              |
| M1.1                                                                          | 11 May 19:22                                                                 | 11 May 19:55   | $1.60 \times 10^{-2}$                                                                           | S10W47                 |              |
|                                                                               | Peak at 19:38, 1F, in AR10758 by G12, HOL and XFL                            |                |                                                                                                 |                        |              |
| CME                                                                           | 11 May 20:13                                                                 |                | 550                                                                                             | 232° - halo            |              |
|                                                                               | CME Lift-off: 11 May 18:36                                                   |                |                                                                                                 |                        |              |
| CME(s)Preceding Main Ejection                                                 |                                                                              |                |                                                                                                 |                        |              |
| CME                                                                           | 11 May 07:32                                                                 |                | 305                                                                                             | 238°(95°)              |              |
| CME                                                                           | 10 May 16:06                                                                 |                | 609                                                                                             | 275° - halo            |              |
| Compact Event: 13- 19 January 2005                                            |                                                                              |                |                                                                                                 |                        |              |
| Type IV                                                                       | 19 Jan. 08:45                                                                | 19 Jan. 09:55  |                                                                                                 |                        | 14- 4.50     |
| Type II                                                                       | 19 Jan. 09:20                                                                | 19 Jan. 24:00  |                                                                                                 |                        | 5.3- 0.040   |
|                                                                               | Type II (Complex, intermittent) and IV <sub>IP</sub> , by <i>Wind</i> /WAVES |                |                                                                                                 |                        |              |
| Type II                                                                       | 19 Jan. 08:12                                                                | 19 Jan. 08:20  |                                                                                                 |                        | 300- 20L     |
| Type IV                                                                       | 19 Jan. 08:05                                                                | 19 Jan. 10:50D |                                                                                                 | N15W51                 | 600- 20L     |
|                                                                               | Coronal Type IV and II by ART-IV and NRH                                     |                |                                                                                                 |                        |              |
| Type III                                                                      | 19 Jan. 08:14                                                                | 19 Jan. 08:45  |                                                                                                 |                        | 400- 1.0L    |
|                                                                               | Two Groups by <i>Wind</i> /WAVES, ART-4 and NRH                              |                |                                                                                                 |                        |              |
| M6.7                                                                          | 19 Jan. 06:58                                                                | 19 Jan. 07:55  | $7.7 \times 10^{-2}$                                                                            | N15W51                 |              |
|                                                                               | Peak at 07:31, in AR10720 by G12 and XFL                                     |                |                                                                                                 |                        |              |
| X1.3                                                                          | 19 Jan. 08:03                                                                | 19 Jan. 08:40  | $2.20 \times 10^{-1}$                                                                           | N15W51                 |              |
|                                                                               | Peak at 08:22, 2N, in AR10720 by G12, LEA and XFL                            |                |                                                                                                 |                        |              |
| CME                                                                           | 19 Jan. 08:29                                                                |                | 2020                                                                                            | 320° - halo            |              |
|                                                                               | CME Lift-off: 19 Jan. 08:02                                                  |                |                                                                                                 |                        |              |
| CME(s)Preceding Main Ejection                                                 |                                                                              |                |                                                                                                 |                        |              |
| CME                                                                           | 18 Jan. 17:14                                                                |                | 287                                                                                             | 305°(43°)              |              |
| CME                                                                           | 17 Jan. 09:30                                                                |                | 2094                                                                                            | 334° - halo            |              |
| CME                                                                           | 17 Jan. 09:54                                                                |                | 2547                                                                                            | 309° - halo            |              |

Table 1.: Type IV<sub>IP</sub> Radio Bursts and Associated Activity-Continued

| Obs.                                                                                           | Start<br>Universal Time | End            | $F_{\text{SXR}}^{\text{tot}}$<br>(J m <sup>-2</sup> )<br>$V_{\text{CME}}$<br>(km s <sup>-1</sup> ) | Position<br>PA - Width | Freq.<br>MHz |
|------------------------------------------------------------------------------------------------|-------------------------|----------------|----------------------------------------------------------------------------------------------------|------------------------|--------------|
| Extended Event: 14 - 17 January 2005                                                           |                         |                |                                                                                                    |                        |              |
| Type IV                                                                                        | 17 Jan. 10:00           | 18 Jan. 02:00  |                                                                                                    |                        | 14 - 4.0     |
| Type II                                                                                        | 17 Jan. 09:25           | 18 Jan. 16:00  |                                                                                                    |                        | 14 - 0.030   |
| Complex, Multi-component Type II and Longest Duration IV <sub>IP</sub> , by <i>Wind</i> /WAVES |                         |                |                                                                                                    |                        |              |
| Type IV                                                                                        | 17 Jan. 08:40           | 17 Jan. 15:24D |                                                                                                    | N15W25                 | 630 - 20L    |
| Coronal Type IV and II by ART-IV and NRH                                                       |                         |                |                                                                                                    |                        |              |
| Type IV                                                                                        | 17 Jan. 17:17           | 18 Jan. 03:00D |                                                                                                    |                        | 630H - 20L   |
| Coronal Type IV and II by CUL, PAL and LEA                                                     |                         |                |                                                                                                    |                        |              |
| Type III                                                                                       | 17 Jan. 09:07           | 17 Jan. 09:59  |                                                                                                    |                        | 630 - 1.0L   |
| Two Groups (GG) by <i>Wind</i> /WAVES, ART-4 and NRH                                           |                         |                |                                                                                                    |                        |              |
| X3.8                                                                                           | 17 Jan. 06:59           | 17 Jan. 10:07  | $8.40 \times 10^{-01}$                                                                             | N15W25                 |              |
| Peak at 09:52, 3B, in AR10720 by G12, XFL and KANZ                                             |                         |                |                                                                                                    |                        |              |
| CME                                                                                            | 17 Jan. 09:54           |                | 2547                                                                                               | 309° - halo            |              |
| CME Lift-off: 17 Jan. 09:38                                                                    |                         |                |                                                                                                    |                        |              |
| CME(s) Preceding Main Ejection                                                                 |                         |                |                                                                                                    |                        |              |
| CME                                                                                            | 17 Jan. 09:30           |                | 2094                                                                                               | 334° - halo            |              |
| Compact Event: 15 - 15 January 2005                                                            |                         |                |                                                                                                    |                        |              |
| Type IV                                                                                        | 15 Jan. 23:30           | 16 Jan. 02:00  |                                                                                                    |                        | 14 - 7.0     |
| Type II                                                                                        | 15 Jan. 23:00           | 16 Jan. 24:00  |                                                                                                    |                        | 3 - 0.040    |
| Type II (Fast Multi-component) and IV <sub>IP</sub> , by <i>Wind</i> /WAVES                    |                         |                |                                                                                                    |                        |              |
| Type IV                                                                                        | 15 Jan. 22:30           | 16 Jan. 03:00D |                                                                                                    |                        | 500H - 30L   |
| Type II                                                                                        | 15 Jan. 22:36           | 15 Jan. 23:00  |                                                                                                    |                        | 200 - 30L    |
| Coronal Type IV and II by CUL                                                                  |                         |                |                                                                                                    |                        |              |
| Type III                                                                                       | 15 Jan. 22:33           | 15 Jan. 23:08  |                                                                                                    |                        | 180 - 1.0L   |
| Group (GG) by <i>Wind</i> /WAVES, and CUL                                                      |                         |                |                                                                                                    |                        |              |
| X2.6                                                                                           | 15 Jan. 22:25           | 0115 23:31     | $6.30 \times 10^{-01}$                                                                             | N15W05                 |              |
| Peak at 23:02, in AR10720 by G12 and XFL                                                       |                         |                |                                                                                                    |                        |              |
| CME                                                                                            | 15 Jan. 23:07           |                | 2861                                                                                               | 323° - halo            |              |
| CME Lift-off: 15 Jan. 22:36                                                                    |                         |                |                                                                                                    |                        |              |
| CME(s) Preceding Main Ejection                                                                 |                         |                |                                                                                                    |                        |              |
| CME                                                                                            | 15 Jan. 06:30           |                | 2049                                                                                               | 359° - halo            |              |

| Table 1.:Type IV <sub>IP</sub> Radio Bursts and Associated Activity-Continued |                                                                          |                |                                                                                                      |                        |              |
|-------------------------------------------------------------------------------|--------------------------------------------------------------------------|----------------|------------------------------------------------------------------------------------------------------|------------------------|--------------|
| Obs.                                                                          | Start<br>Universal Time                                                  | End            | F <sub>SXR</sub> <sup>tot</sup><br>(J m <sup>-2</sup> )<br>V <sub>CME</sub><br>(km s <sup>-1</sup> ) | Position<br>PA - Width | Freq.<br>MHz |
| Compact Event: 16 - 15 January 2005                                           |                                                                          |                |                                                                                                      |                        |              |
| Type IV                                                                       | 15 Jan. 07:00                                                            | 15 Jan. 08:30  |                                                                                                      |                        | 14 - 7.0     |
| Type II                                                                       | 15 Jan. 06:15                                                            | 15 Jan. 09:30  |                                                                                                      |                        | 14 - 0.250   |
|                                                                               | Type II (Chaotic) and IV <sub>IP</sub> , by <i>Wind</i> /WAVES           |                |                                                                                                      |                        |              |
| Type IV                                                                       | 15 Jan. 06:00                                                            | 15 Jan. 10:00D |                                                                                                      | N11E06°                | 630 - 20L    |
|                                                                               | Coronal Type IV by ART-IV and NRH                                        |                |                                                                                                      |                        |              |
| Type III                                                                      | 15 Jan. 06:06                                                            | 15 Jan. 06:40  |                                                                                                      |                        | 630 - 1.0L   |
|                                                                               | Group by <i>Wind</i> /WAVES, ART-4 and NRH                               |                |                                                                                                      |                        |              |
| M8.6                                                                          | 15 Jan. 05:54                                                            | 15 Jan. 07:17  | 2.90 × 10 <sup>-1</sup>                                                                              | N11E06°                |              |
|                                                                               | Peak at 06:38, SF, in AR10720 by G12, XFL and LEA                        |                |                                                                                                      |                        |              |
| CME                                                                           | 15 Jan. 06:30                                                            |                | 2049                                                                                                 | 359° - halo            |              |
|                                                                               | CME Lift-off:15 Jan. 05:57                                               |                |                                                                                                      |                        |              |
| CME(s)Preceding Main Ejection                                                 |                                                                          |                |                                                                                                      |                        |              |
| CME                                                                           | 14 Jan. 17:06                                                            |                | 358                                                                                                  | 238° - halo            |              |
|                                                                               | PoorEvent, Only C2                                                       |                |                                                                                                      |                        |              |
| CME                                                                           | 13 Jan. 23:54                                                            |                | 335                                                                                                  | 058°>250°              |              |
|                                                                               | Uncertain Width, Partial halo                                            |                |                                                                                                      |                        |              |
| Compact Event: 17 - 09 November 2004                                          |                                                                          |                |                                                                                                      |                        |              |
| Type IV                                                                       | 09 Nov. 17:50                                                            | 09 Nov. 19:50  |                                                                                                      |                        | 14 - 7.0     |
| Type II                                                                       | 09 Nov. 17:35                                                            | 09 Nov. 18:10  |                                                                                                      |                        | 14 - 5.0     |
|                                                                               | Type II (Intermittent Tone) and IV <sub>IP</sub> , by <i>Wind</i> /WAVES |                |                                                                                                      |                        |              |
| Type II                                                                       | 09 Nov. 17:24                                                            | 09 Nov. 17:30  |                                                                                                      |                        | 40 - 25L     |
| Type IV                                                                       | 09 Nov. 17:06                                                            | 09 Nov. 20:30D |                                                                                                      |                        | 180H - 25L   |
|                                                                               | Coronal Type IV and II by SAG                                            |                |                                                                                                      |                        |              |
| Type III                                                                      | 09 Nov. 17:00                                                            | 09 Nov. 17:30  |                                                                                                      |                        | 180H - 1.0L  |
|                                                                               | Group by <i>Wind</i> /WAVES, and SAG                                     |                |                                                                                                      |                        |              |
| M8.9                                                                          | 09 Nov. 16:59                                                            | 09 Nov. 17:32  | 9.40 × 10 <sup>-2</sup>                                                                              | N08W51                 |              |
|                                                                               | Peak at 17:19, 2N, in AR10696 by G12, XFL and HOL                        |                |                                                                                                      |                        |              |
| CME                                                                           | 09 Nov. 17:26                                                            |                | 2000                                                                                                 | 299° - halo            |              |
|                                                                               | CME Lift-off: 09 Nov. 16:57                                              |                |                                                                                                      |                        |              |
| CME(s)Preceding Main Ejection                                                 |                                                                          |                |                                                                                                      |                        |              |
| CME                                                                           | 09 Nov. 01:28                                                            |                | 282                                                                                                  | 295°(26°)              |              |
| CME                                                                           | 08 Nov. 11:54                                                            |                | 557                                                                                                  | 310°(27°)              |              |
| CME                                                                           | 08 Nov. 14:54                                                            |                | 605                                                                                                  | 307°(23°)              |              |
| CME                                                                           | 08 Nov. 03:54                                                            |                | 462                                                                                                  | 148° - halo            |              |

Table 1.: Type IV<sub>IP</sub> Radio Bursts and Associated Activity-Continued

| Obs.                                                                               | Start<br>Universal Time | End            | $F_{\text{SXR}}^{\text{tot}}$<br>(J m <sup>-2</sup> )<br>$V_{\text{CME}}$<br>(km s <sup>-1</sup> ) | Position<br>PA - Width | Freq.<br>MHz |
|------------------------------------------------------------------------------------|-------------------------|----------------|----------------------------------------------------------------------------------------------------|------------------------|--------------|
| Compact Event: 18 - 07 November 2004                                               |                         |                |                                                                                                    |                        |              |
| Type IV                                                                            | 07 Nov. 17:10           | 07 Nov. 18:15  |                                                                                                    |                        | 14 - 10      |
| Type II                                                                            | 07 Nov. 16:25           | 08 Nov. 20:00  |                                                                                                    |                        | 14 - 0.060   |
| Type II (Chaotic with multiple tones) and IV <sub>IP</sub> , by <i>Wind</i> /WAVES |                         |                |                                                                                                    |                        |              |
| Type II                                                                            | 07 Nov. 15:59           | 07 Nov. 16:16  |                                                                                                    |                        | 180H - 25L   |
| Type IV                                                                            | 07 Nov. 16:00           | 07 Nov. 19:00D |                                                                                                    |                        | 180H - 25L   |
| Coronal Type IV and II by SAG                                                      |                         |                |                                                                                                    |                        |              |
| Type III                                                                           | 07 Nov. 15:59           | 07 Nov. 16:57  |                                                                                                    |                        | 180H - 1.0L  |
| Group (GG) by <i>Wind</i> /WAVES, and SAG                                          |                         |                |                                                                                                    |                        |              |
| X2.0                                                                               | 07 Nov. 15:42           | 07 Nov. 16:15  | $2.00 \times 10^{-1}$                                                                              | N09W17                 |              |
| Peak at 16:06, in AR10696 by G12 and XFL                                           |                         |                |                                                                                                    |                        |              |
| CME                                                                                | 07 Nov. 16:54           |                | 1759                                                                                               | 00° - halo             |              |
| CME Lift-off: 07 Nov. 16:16                                                        |                         |                |                                                                                                    |                        |              |
| CME(s) Preceding Main Ejection                                                     |                         |                |                                                                                                    |                        |              |
| CME                                                                                | 07 Nov. 14:30           |                | 226                                                                                                | 298°(100°)             |              |
| CME                                                                                | 06 Nov. 02:06           |                | 1111                                                                                               | 21°(>214°)             |              |
| Poor Event with Uncertain Width, Partial halo                                      |                         |                |                                                                                                    |                        |              |
| CME                                                                                | 06 Nov. 01:32           |                | 818                                                                                                | 23° - halo             |              |
| Compact Event: 19 - 06 November 2004                                               |                         |                |                                                                                                    |                        |              |
| Type IV                                                                            | 06 Nov. 01:20           | 06 Nov. 02:30  |                                                                                                    |                        | 14 - 10      |
| Type II                                                                            | 06 Nov. 01:50           | 06 Nov. 02:45  |                                                                                                    |                        | 6 - 0.70     |
| Type II and IV <sub>IP</sub> , by <i>Wind</i> /WAVES                               |                         |                |                                                                                                    |                        |              |
| Type IV                                                                            | 06 Nov. 00:33           | 06 Nov. 02:45  |                                                                                                    |                        | 1000 - 18L   |
| Type II                                                                            | 06 Nov. 00:44           | 06 Nov. 00:58  |                                                                                                    |                        | 80 - 25      |
| Coronal Type IV and II by LEA and CUL                                              |                         |                |                                                                                                    |                        |              |
| Type III                                                                           | 06 Nov. 00:44           | 06 Nov. 00:58  |                                                                                                    |                        | 1000 - 1.0L  |
| Type III                                                                           | 06 Nov. 01:40           | 06 Nov. 01:43  |                                                                                                    |                        | 1000 - 1.0L  |
| Two Groups by <i>Wind</i> /WAVES and CUL                                           |                         |                |                                                                                                    |                        |              |
| M9.3                                                                               | 06 Nov. 00:11           | 06 Nov. 00:42  | $6.50 \times 10^{-2}$                                                                              | N10E08                 |              |
| Peak at 00:34, 2N, in 10696 by G12, XFL and LEA                                    |                         |                |                                                                                                    |                        |              |
| M5.9                                                                               | 06 Nov. 00:44           | 06 Nov. 01:10  | $8.50 \times 10^{-2}$                                                                              | N10E05                 |              |
| Peak at 00:57, 1N, in 10696 by G12 and CUL                                         |                         |                |                                                                                                    |                        |              |
| M3.6                                                                               | 06 Nov. 01:40           | 06 Nov. 02:08  | $5.50 \times 10^{-2}$                                                                              | N07E00                 |              |
| Peak at 01:57, 1N, in AR10696 by G12 and CUL                                       |                         |                |                                                                                                    |                        |              |
| CME                                                                                | 06 Nov. 01:32           |                | 818                                                                                                | 23° - halo             |              |
| CME Lift-off: 06 Nov. 00:38                                                        |                         |                |                                                                                                    |                        |              |

| Table 1.:Type IV <sub>IP</sub> Radio Bursts and Associated Activity-Continued |                                                                                       |                                              |                                                                                                 |                        |              |
|-------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|----------------------------------------------|-------------------------------------------------------------------------------------------------|------------------------|--------------|
| Obs.                                                                          | Start<br>Universal Time                                                               | End                                          | $F_{\text{SXR}}^{tot}$<br>(J m <sup>-2</sup> )<br><br>$V_{\text{CME}}$<br>(km s <sup>-1</sup> ) | Position<br>PA - Width | Freq.<br>MHz |
| CME(s)Preceding Main Ejection                                                 |                                                                                       |                                              |                                                                                                 |                        |              |
| CME                                                                           | 06 Nov. 02:06                                                                         |                                              | 1111                                                                                            | 21°(>214°)             |              |
|                                                                               |                                                                                       | PoorEvent with Uncertain Width, Partial halo |                                                                                                 |                        |              |
| CME                                                                           | 06 Nov. 23:30                                                                         |                                              | 1055                                                                                            | 31°(>293°)             |              |
|                                                                               |                                                                                       | Uncertain Width; Partial halo                |                                                                                                 |                        |              |
| Compact Event: 20 - 29 July 2004                                              |                                                                                       |                                              |                                                                                                 |                        |              |
| Type IV                                                                       | 29 July 12:40                                                                         | 29 July 14:30                                |                                                                                                 |                        | 14 - 3.0     |
| Type II                                                                       | 29 July 13:20                                                                         | 29 July 20:30                                |                                                                                                 |                        | 1.0 - 0.05   |
|                                                                               | Type II (Continuous tone with structure) and IV <sub>IP</sub> , by <i>Wind</i> /WAVES |                                              |                                                                                                 |                        |              |
| Type IV                                                                       | 29 July 11:30                                                                         | 29 July 13:30                                |                                                                                                 | S00W90                 | 180H - 25L   |
|                                                                               |                                                                                       | Coronal Type IV by SVI                       |                                                                                                 |                        |              |
| Type III                                                                      | 29 July 10:57                                                                         | 29 July 12:26                                |                                                                                                 |                        | 180H - 1.0L  |
|                                                                               | Several Groures (GG and G) by <i>Wind</i> /WAVES, and SVI                             |                                              |                                                                                                 |                        |              |
| C2.1                                                                          | 29 July 11:42                                                                         | 29 July 14:02                                | $1.20 \times 10^{-2}$                                                                           |                        |              |
|                                                                               | Peak at 13:04, in AR10652 by G12                                                      |                                              |                                                                                                 |                        |              |
| CME                                                                           | 29 July 12:06                                                                         |                                              | 1180                                                                                            | 245° - halo            |              |
|                                                                               | CME Lift-off: 29 July 11:51                                                           |                                              |                                                                                                 |                        |              |
| CME(s)Preceding Main Ejection                                                 |                                                                                       |                                              |                                                                                                 |                        |              |
| CME                                                                           | 29 July 09:30                                                                         |                                              | 275                                                                                             | 241°(48°)              |              |
| CME                                                                           | 28 July 03:30                                                                         |                                              | 754                                                                                             | 284°(>201°)            |              |
|                                                                               | Uncertain Width, Partial halo                                                         |                                              |                                                                                                 |                        |              |
| Compact Event: 21 - 25 July 2004                                              |                                                                                       |                                              |                                                                                                 |                        |              |
| Type IV                                                                       | 25 July 15:10                                                                         | 25 July 20:30                                |                                                                                                 |                        | 14 - 2.0     |
| Type II                                                                       | 25 July 15:00                                                                         | 26 July 22:25                                |                                                                                                 |                        | 1.0 - 0.028  |
|                                                                               | Type II (Complex with many bands) and IV <sub>IP</sub> , by <i>Wind</i> /WAVES        |                                              |                                                                                                 |                        |              |
| Type IV                                                                       | 25 July 14:15                                                                         | 25 July 17:31                                |                                                                                                 | N04W30                 | 180H - 25L   |
|                                                                               | Coronal Type IV by SVI and NRH                                                        |                                              |                                                                                                 |                        |              |
| Type III                                                                      | 24 July 13:18                                                                         | 24 July 15:10                                |                                                                                                 |                        | 180H - 1.0L  |
|                                                                               | Type III Groups by <i>Wind</i> /WAVES, and SVI                                        |                                              |                                                                                                 |                        |              |
| C2.1                                                                          | 24 July 13:18                                                                         | 24 July 13:32                                | $1.50 \times 10^{-3}$                                                                           | N04W29                 |              |
|                                                                               | Peak at 13:25, in AR10652 by G12 and XFL                                              |                                              |                                                                                                 |                        |              |
| M2.2                                                                          | 24 July 13:37                                                                         | 24 July 13:55                                | $1.30 \times 10^{-2}$                                                                           | N04W30                 |              |
|                                                                               | Peak at 13:49, in AR10652 by G12 and XFL                                              |                                              |                                                                                                 |                        |              |
| M1.1                                                                          | 25 July 14:19                                                                         | 25 July 16:43                                | $6.50 \times 10^{-2}$                                                                           | N08W33                 |              |
|                                                                               | Peak at 15:14, 1F, in AR10652 by G12 and HOL                                          |                                              |                                                                                                 |                        |              |
| CME                                                                           | 25 July 14:54                                                                         |                                              | 1333                                                                                            | 204° - halo            |              |
|                                                                               | CME Lift-off: 25 July 14:32                                                           |                                              |                                                                                                 |                        |              |

| Table 1.:Type IV <sub>IP</sub> Radio Bursts and Associated Activity-Continued |                                                      |               |                                                         |                        |              |
|-------------------------------------------------------------------------------|------------------------------------------------------|---------------|---------------------------------------------------------|------------------------|--------------|
| Obs.                                                                          | Start                                                | End           | F <sub>SXR</sub> <sup>tot</sup><br>(J m <sup>-2</sup> ) | Position<br>PA - Width | Freq.<br>MHz |
|                                                                               | Universal Time                                       |               | V <sub>CME</sub><br>(km s <sup>-1</sup> )               |                        |              |
| CME(s)Preceding Main Ejection                                                 |                                                      |               |                                                         |                        |              |
| CME                                                                           | 25 July 14:30                                        |               | 450                                                     | 229°(45°)              |              |
| CME                                                                           | 25 July 13:32                                        |               | 556                                                     | 242°(16°)              |              |
| CME                                                                           | 25 July 06:54                                        |               | 299                                                     | 296°(31°)              |              |
| CME                                                                           | 24 July 23:54                                        |               | 555                                                     | 215°(78°)              |              |
| Compact Event: 22- 23 July 2004                                               |                                                      |               |                                                         |                        |              |
| Type IV                                                                       | 23 July 19:30                                        | 23 July 20:30 |                                                         |                        | 14 - 7.0     |
| Type II                                                                       | 23 July 19:00                                        | 23 July 19:35 |                                                         |                        | 1 - 2.5      |
|                                                                               | Type II and IV <sub>IP</sub> , by <i>Wind</i> /WAVES |               |                                                         |                        |              |
| Type IV                                                                       | 23 July 18:30                                        | 23 July 21:30 |                                                         |                        | 180H - 25L   |
|                                                                               | Coronal Type IV by PAL                               |               |                                                         |                        |              |
| Type III                                                                      | 23 July 17:30                                        | 23 July 18:30 |                                                         |                        | 180H - 1.0L  |
|                                                                               | Type III Group (GG) by <i>Wind</i> /WAVES, and PAL   |               |                                                         |                        |              |
| M2.2                                                                          | 23 July 17:07                                        | 23 July 17:35 | 1.50 × 10 <sup>-2</sup>                                 | N04W08                 |              |
|                                                                               | Peak at 17:28, in AR10652 by G12 and XFL             |               |                                                         |                        |              |
| C4.1                                                                          | 23 July 18:02                                        | 23 July 18:11 | 1.70 × 10 <sup>-3</sup>                                 | N05W05                 |              |
|                                                                               | Peak at 18:07, in AR10652 by G12 and XFL             |               |                                                         |                        |              |
| M1.7                                                                          | 23 July 21:15                                        | 23 July 21:30 | 9.00 × 10 <sup>-3</sup>                                 | N05W07                 |              |
|                                                                               | Peak at 21:23, in AR10652 by G12 and XFL             |               |                                                         |                        |              |
| CME                                                                           | 23 July 19:32                                        |               | 874                                                     | 187°(100°)             |              |
|                                                                               | CME Lift-off: 23 July 18:47                          |               |                                                         |                        |              |
| CME(s)Preceding Main Ejection                                                 |                                                      |               |                                                         |                        |              |
| CME                                                                           | 23 July 16:06                                        |               | 824                                                     | 278° - halo            |              |
| CME                                                                           | 23 July 17:54                                        |               | 569                                                     | 256°(142°)             |              |
| CME                                                                           | 23 July 07:32                                        |               | 459                                                     | 218°(138°)             |              |
|                                                                               | Two Partial haloes                                   |               |                                                         |                        |              |
| Compact Event: 23- 04 November 2003                                           |                                                      |               |                                                         |                        |              |
| Type IV                                                                       | 04 Nov. 20:20                                        | 04 Nov. 21:00 |                                                         |                        | 14 - 10      |
| Type II                                                                       | 04 Nov. 20:00                                        | 04 Nov. 24:00 |                                                         |                        | 10 - 0.20    |
|                                                                               | Type II and IV <sub>IP</sub> , by <i>Wind</i> /WAVES |               |                                                         |                        |              |
| Type IV                                                                       | 04 Nov. 19:35                                        | 04 Nov. 21:00 |                                                         |                        | 300H - 25L   |
|                                                                               | Coronal Type IV by HOL and CUL (after 20:00)         |               |                                                         |                        |              |
| Type III                                                                      | 04 Nov. 19:35                                        | 04 Nov. 20:38 |                                                         |                        | 180H - 1.0L  |
|                                                                               | Type III Groups by <i>Wind</i> /WAVES, and HOL       |               |                                                         |                        |              |
| X17.4                                                                         | 04 Nov. 19:29                                        | 04 Nov. 20:06 | 2.30                                                    | S19W83                 |              |
|                                                                               | Peak at 19:53, 3B, in AR10486 by G12 and HOL         |               |                                                         |                        |              |
| CME                                                                           | 04 Nov. 19:54                                        |               | 2657                                                    | 260° - halo            |              |
|                                                                               | CME Lift-off: 04 Nov. 19:38, 3 Points                |               |                                                         |                        |              |



| Table 1.:Type IV <sub>IP</sub> Radio Bursts and Associated Activity-Continued              |                         |               |                                                                                                    |                        |              |
|--------------------------------------------------------------------------------------------|-------------------------|---------------|----------------------------------------------------------------------------------------------------|------------------------|--------------|
| Obs.                                                                                       | Start<br>Universal Time | End           | $F_{\text{SXR}}^{\text{tot}}$<br>(J m <sup>-2</sup> )<br>$V_{\text{CME}}$<br>(km s <sup>-1</sup> ) | Position<br>PA - Width | Freq.<br>MHz |
| CME(s)Preceding Main Ejection                                                              |                         |               |                                                                                                    |                        |              |
| CME                                                                                        | 04 Nov. 19:32           |               | 327                                                                                                | 187°(52°)              |              |
| CME                                                                                        | 04 Nov. 12:54           |               | 605                                                                                                | 263°(72°)              |              |
| CME                                                                                        | 04 Nov. 12:06           |               | 1208                                                                                               | 84° - halo             |              |
| Compact Event: 24 - 03 November 2003                                                       |                         |               |                                                                                                    |                        |              |
| Type IV                                                                                    | 03 Nov. 10:15           | 03 Nov. 11:15 |                                                                                                    |                        | 14 - 6.0     |
| Type II                                                                                    | 03 Nov. 10:00           | 03 Nov. 12:30 |                                                                                                    |                        | 6 - 0.40     |
| Type II (Complex F-H) and IV <sub>IP</sub> (with drifting features), by <i>Wind</i> /WAVES |                         |               |                                                                                                    |                        |              |
| Type IV                                                                                    | 03 Nov. 09:50           | 03 Nov. 11:40 |                                                                                                    | N08W77                 | 500 - 20L    |
| Type II                                                                                    | 03 Nov. 09:51           | 03 Nov. 10:12 |                                                                                                    |                        | 200 - 20L    |
| Coronal Type IV and II by ART-IV and NRH                                                   |                         |               |                                                                                                    |                        |              |
| Type III                                                                                   | 03 Nov. 09:49           | 03 Nov. 10:05 |                                                                                                    |                        | 500H - 1.0L  |
| Groups (GG) by <i>Wind</i> /WAVES, ART-IV and NRH                                          |                         |               |                                                                                                    |                        |              |
| X3.9                                                                                       | 03 Nov. 09:43           | 03 Nov. 10:19 | $5.60 \times 10^{-1}$                                                                              | N08W77                 |              |
| Peak at 09:55, 2F, in AR10488 by G12 and LEA                                               |                         |               |                                                                                                    |                        |              |
| CME                                                                                        | 03 Nov. 10:06           |               | 1420                                                                                               | 301°(103°)             |              |
| CME Lift-off:03 Nov. 09:45                                                                 |                         |               |                                                                                                    |                        |              |
| CME(s)Preceding Main Ejection                                                              |                         |               |                                                                                                    |                        |              |
| CME                                                                                        | 03 Nov. 01:59           |               | 827                                                                                                | 324°(65°)              |              |
| Compact Event: 25 - 03 November 2003                                                       |                         |               |                                                                                                    |                        |              |
| Type IV                                                                                    | 03 Nov. 02:10           | 03 Nov. 03:05 |                                                                                                    |                        | 14 - 9.0     |
| Type II                                                                                    | 03 Nov. 01:15           | 03 Nov. 01:25 |                                                                                                    |                        | 3.0 - 1.5    |
| TypeII (Multiple brief tones) and IV <sub>IP</sub> , by <i>Wind</i> /WAVES                 |                         |               |                                                                                                    |                        |              |
| Type IV                                                                                    | 03 Nov. 01:31           | 03 Nov. 04:00 |                                                                                                    |                        | 500H - 18L   |
| Type II                                                                                    | 03 Nov. 01:24           | 03 Nov. 01:30 |                                                                                                    |                        | 200 - 18L    |
| Coronal Type IV and II by CUL and LEA                                                      |                         |               |                                                                                                    |                        |              |
| Type III                                                                                   | 03 Nov. 00:58           | 03 Nov. 01:34 |                                                                                                    |                        | 250 - 1.0L   |
| Group (GG) by <i>Wind</i> /WAVES and CUL                                                   |                         |               |                                                                                                    |                        |              |
| X2.7                                                                                       | 03 Nov. 01:09           | 03 Nov. 01:45 | $3.60 \times 10^{-1}$                                                                              | N10W83                 |              |
| Peak at 01:30, 2B, in AR10488 by G12 and LEA                                               |                         |               |                                                                                                    |                        |              |
| CME                                                                                        | 03 Nov. 01:59           |               | 827                                                                                                | 324°(65°)              |              |
| CME Lift-off:03 Nov. 00:52                                                                 |                         |               |                                                                                                    |                        |              |
| CME(s)Preceding Main Ejection                                                              |                         |               |                                                                                                    |                        |              |
| CME                                                                                        | 01 Nov. 21:30           |               | 413                                                                                                | 320°(>143°)            |              |
| Uncertain Width, Partial halo                                                              |                         |               |                                                                                                    |                        |              |

Table 1.:Type IV<sub>IP</sub> Radio Bursts and Associated Activity-Continued

| Obs.                               | Start<br>Universal Time                                                     | End            | $F_{\text{SXR}}^{\text{tot}}$<br>(J m <sup>-2</sup> )<br>$V_{\text{CME}}$<br>(km s <sup>-1</sup> ) | Position<br>PA - Width | Freq.<br>MHz |
|------------------------------------|-----------------------------------------------------------------------------|----------------|----------------------------------------------------------------------------------------------------|------------------------|--------------|
| Compact Event: 26-02 November 2003 |                                                                             |                |                                                                                                    |                        |              |
| Type IV                            | 02 Nov. 17:55                                                               | 02 Nov. 18:50  |                                                                                                    |                        | 14-8.0       |
| Type II                            | 02 Nov. 17:30                                                               | 03 Nov. 01:00  |                                                                                                    |                        | 12-0.25      |
|                                    | Type II (Chaotic and intense) and IV <sub>IP</sub> , by <i>Wind</i> /WAVES  |                |                                                                                                    |                        |              |
| Type IV                            | 02 Nov. 17:14                                                               | 02 Nov. 18:24  |                                                                                                    |                        | 80-25L       |
| Type II                            | 02 Nov. 17:14                                                               | 02 Nov. 17:37  |                                                                                                    |                        | 180-25L      |
|                                    | Coronal Type IV and II by HOL                                               |                |                                                                                                    |                        |              |
| Type III                           | 02 Nov. 17:14                                                               | 02 Nov. 17:48  |                                                                                                    |                        | 180-1.0L     |
|                                    | Group (GG) by <i>Wind</i> /WAVES and HOL                                    |                |                                                                                                    |                        |              |
| X8.3                               | 02 Nov. 17:03                                                               | 02 Nov. 17:39  | $9.10 \times 10^{-1}$                                                                              | S14W56                 |              |
|                                    | Peak at 17:25, 2B, in AR10486 by G12 and HOL                                |                |                                                                                                    |                        |              |
| CME                                | 02 Nov. 17:30                                                               |                | 2598                                                                                               | 265° - halo            |              |
|                                    | CME Lift-off:02 Nov. 17:16                                                  |                |                                                                                                    |                        |              |
| CME(s)Preceding Main Ejection      |                                                                             |                |                                                                                                    |                        |              |
| CME                                | 02 Nov. 11:30                                                               |                | 826                                                                                                | 226°(33°)              |              |
| CME                                | 02 Nov. 09:30                                                               |                | 2036                                                                                               | 195° - halo            |              |
| Compact Event: 27-29 October 2003  |                                                                             |                |                                                                                                    |                        |              |
| Type IV                            | 29 Oct. 21:15                                                               | 29 Oct. 22:30  |                                                                                                    |                        | 14-5.0       |
| Type II                            | 29 Oct. 20:55                                                               | 29 Oct. 24:00  |                                                                                                    |                        | 11-0.50      |
|                                    | Type II (Difficult to observe) and IV <sub>IP</sub> , by <i>Wind</i> /WAVES |                |                                                                                                    |                        |              |
| Type IV                            | 29 Oct. 20:39                                                               | 29 Oct. 21:00D |                                                                                                    |                        | 500H-20L     |
| Type II                            | 29 Oct. 20:42                                                               | 29 Oct. 20:55  |                                                                                                    |                        | 18-430       |
|                                    | Coronal Type IV and II by CUL                                               |                |                                                                                                    |                        |              |
| Type III                           | 29 Oct. 20:49                                                               | 29 Oct. 21:00  |                                                                                                    |                        | 500H-1.0L    |
|                                    | Group (GG) by <i>Wind</i> /WAVES and CUL                                    |                |                                                                                                    |                        |              |
| X10.0                              | 29 Oct. 20:37                                                               | 29 Oct. 21:01  | $8.70 \times 10^{-1}$                                                                              | S15W02                 |              |
|                                    | Peak at 20:49, 2B, in AR10486 by G12 and HOL                                |                |                                                                                                    |                        |              |
| CME                                | 29 Oct. 20:54                                                               |                | 2029                                                                                               | 190° - halo            |              |
|                                    | CME Lift-off:29 Oct. 20:36                                                  |                |                                                                                                    |                        |              |
| CME(s)Preceding Main Ejection      |                                                                             |                |                                                                                                    |                        |              |
| CME                                | 29 Oct. 10:17                                                               |                | 922                                                                                                | 182°(114°)             |              |
|                                    | Very PoorEvent, C2 Only.                                                    |                |                                                                                                    |                        |              |

| Table 1.:Type IV <sub>IP</sub> Radio Bursts and Associated Activity-Continued |                                                                       |                                               |                                                                                                    |                        |              |
|-------------------------------------------------------------------------------|-----------------------------------------------------------------------|-----------------------------------------------|----------------------------------------------------------------------------------------------------|------------------------|--------------|
| Obs.                                                                          | Start<br>Universal Time                                               | End                                           | $F_{\text{SXR}}^{\text{tot}}$<br>(J m <sup>-2</sup> )<br>$V_{\text{CME}}$<br>(km s <sup>-1</sup> ) | Position<br>PA - Width | Freq.<br>MHz |
| <hr/> <hr/>                                                                   |                                                                       |                                               |                                                                                                    |                        |              |
| Compact Event: 28-29 October 2003                                             |                                                                       |                                               |                                                                                                    |                        |              |
| Type IV                                                                       | 29 Oct. 06:00                                                         | 29 Oct. 11:00                                 |                                                                                                    |                        | 14- 9.0      |
|                                                                               |                                                                       | Type IV <sub>IP</sub> , by <i>Wind</i> /WAVES |                                                                                                    |                        |              |
| Type IV                                                                       | 29 Oct. 05:35                                                         | 29 Oct. 13:00D                                |                                                                                                    | S20W08                 | 200- 20L     |
|                                                                               | Coronal Type IV and II by ART-IV, SVI, HOL and NRH ( after 10:00)     |                                               |                                                                                                    |                        |              |
| Type III                                                                      | 29 Oct. 04:27                                                         | 29 Oct. 10:00                                 |                                                                                                    |                        | 180H- 1.0L   |
|                                                                               | Groups (GG) by <i>Wind</i> /WAVES, ART-4 and SVI                      |                                               |                                                                                                    |                        |              |
| M3.5                                                                          | 29 Oct. 04:08                                                         | 29 Oct. 05:54                                 | $1.20 \times 10^{-1}$                                                                              | S17E06                 |              |
|                                                                               | Peak at 05:11, SN, in AR10486 by G12 and LEA                          |                                               |                                                                                                    |                        |              |
| CME                                                                           | 29 Oct. 10:17                                                         |                                               | 922                                                                                                | 200°(114°)             |              |
|                                                                               | CME Lift-off:29 Oct. 09:00, Very PoorEvent, C3 Only                   |                                               |                                                                                                    |                        |              |
| NO LASCO CMEs recorded from 28 October 11:30 to 29 October 10:17 UT.          |                                                                       |                                               |                                                                                                    |                        |              |
| <hr/> <hr/>                                                                   |                                                                       |                                               |                                                                                                    |                        |              |
| Compact Event: 29-29 October 2003                                             |                                                                       |                                               |                                                                                                    |                        |              |
| Type IV                                                                       | 29 Oct. 01:30                                                         | 29 Oct. 04:00                                 |                                                                                                    |                        | 14- 7.0      |
|                                                                               |                                                                       | Type IV <sub>IP</sub> , by <i>Wind</i> /WAVES |                                                                                                    |                        |              |
| Type IV                                                                       | 29 Oct. 00:37                                                         | 29 Oct. 03:55D                                |                                                                                                    |                        | 180H- 25L    |
|                                                                               | Coronal Type IV and II by LEA                                         |                                               |                                                                                                    |                        |              |
| Type III                                                                      | 29 Oct. 00:21                                                         | 29 Oct. 01:29                                 |                                                                                                    |                        | 180H- 1.0L   |
|                                                                               | by <i>Wind</i> /WAVES and LEA                                         |                                               |                                                                                                    |                        |              |
| M1.1                                                                          | 29 Oct. 00:26                                                         | 29 Oct. 02:08                                 | $5.20 \times 10^{-02}$                                                                             | S18E08                 |              |
|                                                                               | Peak at 01:51, 1F, in AR10486 by G12 and LEA                          |                                               |                                                                                                    |                        |              |
| NO LASCO CMEs recorded from 28 October 11:30 to 29 October 10:17 UT.          |                                                                       |                                               |                                                                                                    |                        |              |
| <hr/> <hr/>                                                                   |                                                                       |                                               |                                                                                                    |                        |              |
| Compact Event: 30-28 October 2003                                             |                                                                       |                                               |                                                                                                    |                        |              |
| Type IV                                                                       | 28 Oct. 11:30                                                         | 28 Oct. 15:00                                 |                                                                                                    |                        | 14- 5.0      |
| Type II                                                                       | 28 Oct. 11:10                                                         | 29 Oct. 24:00                                 |                                                                                                    |                        | 14- 0.04     |
|                                                                               | Strongest type II and IV <sub>IP</sub> observed by <i>Wind</i> /WAVES |                                               |                                                                                                    |                        |              |
| Type IV                                                                       | 28 Oct. 10:38                                                         | 28 Oct. 14:00D                                |                                                                                                    | S16E08                 | 550- 20L     |
| Type II                                                                       | 28 Oct. 11:05                                                         | 28 Oct. 11:17                                 |                                                                                                    |                        | 550- 20L     |
|                                                                               | Coronal Type IV and II by ART-IV and NRH ( after 10:00)               |                                               |                                                                                                    |                        |              |
| Type III                                                                      | 28 Oct. 10:58                                                         | 28 Oct. 11:22                                 |                                                                                                    |                        | 550- 1.0L    |
|                                                                               | Group (GG) by <i>Wind</i> /WAVES, and ART-IV                          |                                               |                                                                                                    |                        |              |
| X17.2                                                                         | 28 Oct. 09:51                                                         | 1028 11:24                                    | 1.80                                                                                               | S16E08                 |              |
|                                                                               | Peak at 11:10, 4B, in AR10486 by G12 and SVI                          |                                               |                                                                                                    |                        |              |
| CME                                                                           | 28 Oct. 11:30                                                         |                                               | 2459                                                                                               | 15° -halo              |              |
|                                                                               | CME Lift-off: 28 Oct. 11:01                                           |                                               |                                                                                                    |                        |              |
| <hr/>                                                                         |                                                                       |                                               |                                                                                                    |                        |              |
| CME(s)Preceding Main Ejection                                                 |                                                                       |                                               |                                                                                                    |                        |              |
| CME                                                                           | 28 Oct. 09:30                                                         |                                               | 853                                                                                                | 86°(22°)               |              |
| CME                                                                           | 27 Oct. 20:30                                                         |                                               | 990                                                                                                | 322°(43°)              |              |
| CME                                                                           | 27 Oct. 13:32                                                         |                                               | 1005                                                                                               | 326°(45°)              |              |

| Table 1.:Type IV <sub>IP</sub> Radio Bursts and Associated Activity-Continued |                         |                                                     |                                                                                                    |                        |              |
|-------------------------------------------------------------------------------|-------------------------|-----------------------------------------------------|----------------------------------------------------------------------------------------------------|------------------------|--------------|
| Obs.                                                                          | Start<br>Universal Time | End                                                 | $F_{\text{SXR}}^{\text{tot}}$<br>(J m <sup>-2</sup> )<br>$V_{\text{CME}}$<br>(km s <sup>-1</sup> ) | Position<br>PA - Width | Freq.<br>MHz |
| Compact Event: 31 - 28 May 2003                                               |                         |                                                     |                                                                                                    |                        |              |
| Type IV                                                                       | 28 May 01:00            | 28 May 03:00                                        |                                                                                                    |                        | 14 - 10      |
|                                                                               |                         | Type IV <sub>IP</sub> , by <i>Wind</i> /WAVES       |                                                                                                    |                        |              |
| Type IV                                                                       | 28 May 00:23            | 28 May 02:41                                        |                                                                                                    |                        | 500H - 40    |
|                                                                               |                         | Coronal Type IV by CUL                              |                                                                                                    |                        |              |
| Type III                                                                      | 28 May 00:23            | 28 May 01:14                                        |                                                                                                    |                        | 500H - 1.0L  |
|                                                                               |                         | Two Groups (GG) by <i>Wind</i> /WAVES and CUL       |                                                                                                    |                        |              |
| X3.6                                                                          | 28 May 00:17            | 28 May 00:39                                        | $2.80 \times 10^{-1}$                                                                              | S08W22                 |              |
|                                                                               |                         | Peak at 00:27, 1B, in AR10365 by G12 and MIT        |                                                                                                    |                        |              |
| CME                                                                           | 28 May 00:50            |                                                     | 1366                                                                                               | 292° - halo            |              |
|                                                                               |                         | CME Lift-off: 28 May 00:13                          |                                                                                                    |                        |              |
| CME(s)Preceding Main Ejection                                                 |                         |                                                     |                                                                                                    |                        |              |
| CME                                                                           | 27 May 23:50            |                                                     | 964                                                                                                | 67° - halo             |              |
| CME                                                                           | 27 May 22:06            |                                                     | 1122                                                                                               | 225°(123°)             |              |
|                                                                               |                         | CME Lift-off: 25 Apr. 05:04, Partial halo           |                                                                                                    |                        |              |
| Compact Event: 32 - 25 April 2003                                             |                         |                                                     |                                                                                                    |                        |              |
| Type IV                                                                       | 25 Apr. 05:55           | 25 Apr. 06:10                                       |                                                                                                    |                        | 14 - 9.0     |
|                                                                               |                         | Type IV <sub>IP</sub> , by <i>Wind</i> /WAVES       |                                                                                                    |                        |              |
| Type IV                                                                       | 25 Apr. 05:31           | 25 Apr. 05:46                                       |                                                                                                    |                        | 124 - 25L    |
| Type II                                                                       | 25 Apr. 05:41           | 25 Apr. 05:55                                       |                                                                                                    |                        | 180 - 25L    |
|                                                                               |                         | Coronal Type IV and II (F-M) by CUL and LEA         |                                                                                                    |                        |              |
| Type III                                                                      | 25 Apr. 05:24           | 25 Apr. 05:56                                       |                                                                                                    |                        | 360 - 1.0L   |
|                                                                               |                         | Three Goups (GG) by <i>Wind</i> /WAVES, CUL and LEA |                                                                                                    |                        |              |
| M1.2                                                                          | 25 Apr. 05:23           | 25 Apr. 05:58                                       | $1.80 \times 10^{-2}$                                                                              | N14E79                 |              |
|                                                                               |                         | Peak at 05:40, SF, in AR10346 by G10 and LEA        |                                                                                                    |                        |              |
| CME                                                                           | 25 Apr. 05:50           |                                                     | 806                                                                                                | 54°(235°)              |              |
|                                                                               |                         | CME Lift-off: 25 Apr. 05:04, Partial halo           |                                                                                                    |                        |              |
| CME(s)Preceding Main Ejection                                                 |                         |                                                     |                                                                                                    |                        |              |
| CME                                                                           | 24 Apr. 02:50           | 459                                                 | 51°(138°)                                                                                          |                        |              |
|                                                                               |                         | PoorEvent.                                          |                                                                                                    |                        |              |
| CME                                                                           | 24 Apr. 22:26           |                                                     | 347                                                                                                | 59°(47°)               |              |

| Table 1.:Type IV <sub>IP</sub> Radio Bursts and Associated Activity-Continued |                                                                             |                |                                                                                                    |                        |              |
|-------------------------------------------------------------------------------|-----------------------------------------------------------------------------|----------------|----------------------------------------------------------------------------------------------------|------------------------|--------------|
| Obs.                                                                          | Start<br>Universal Time                                                     | End            | $F_{\text{SXR}}^{\text{tot}}$<br>(J m <sup>-2</sup> )<br>$V_{\text{CME}}$<br>(km s <sup>-1</sup> ) | Position<br>PA - Width | Freq.<br>MHz |
| Compact Event: 33- 16 August 2002                                             |                                                                             |                |                                                                                                    |                        |              |
| Type IV                                                                       | 16 Aug. 12:20                                                               | 16 Aug. 16:30  |                                                                                                    |                        | 14 - 4.0     |
| Type II                                                                       | 16 Aug. 12:20                                                               | 17 Aug. 21:00  |                                                                                                    |                        | 14 - 0.060   |
|                                                                               | Type IV <sub>IP</sub> and II (Multiple bands), by <i>Wind</i> /WAVES        |                |                                                                                                    |                        |              |
| Type IV                                                                       | 16 Aug. 12:05                                                               | 16 Aug. 17:56D |                                                                                                    | S14E20                 | 180H - 25L   |
|                                                                               | Coronal Type IV by SVI and NRH                                              |                |                                                                                                    |                        |              |
| Type III                                                                      | 16 Aug. 11:32                                                               | 16 Aug. 13:00  |                                                                                                    |                        | 180H - 1.0L  |
|                                                                               | Several Groups (G–GG) by <i>Wind</i> /WAVES, SVI and NRH                    |                |                                                                                                    |                        |              |
| M5.2                                                                          | 16 Aug. 11:32                                                               | 16 Aug. 13:07  | $1.60 \times 10^{-1}$                                                                              | S14E20                 |              |
|                                                                               | Peak at 12:32, 2N, in AR10069 by G08 and SVI                                |                |                                                                                                    |                        |              |
| CME                                                                           | 16 Aug. 12:30                                                               |                | 1585                                                                                               | 121° - halo            |              |
|                                                                               | CME Lift-off: 16 Aug. 12:01                                                 |                |                                                                                                    |                        |              |
| CME(s)Preceding Main Ejection                                                 |                                                                             |                |                                                                                                    |                        |              |
| CME                                                                           | 14 Aug. 10:54                                                               |                | 809                                                                                                | 142°(52°)              |              |
| CME                                                                           | 14 Aug. 16:54                                                               |                | 1049                                                                                               | 100°(16°)              |              |
|                                                                               | 3 points only.                                                              |                |                                                                                                    |                        |              |
| ExtendedEvent: 34- 18-23 May 2002                                             |                                                                             |                |                                                                                                    |                        |              |
| Type IV                                                                       | 18 May 09:00                                                                | 23 May 04:00   |                                                                                                    |                        | 9 - 0.400    |
|                                                                               | Possible moving Type IV <sub>IP</sub> , by <i>Wind</i> /WAVES. Very intense |                |                                                                                                    |                        |              |
| CME                                                                           | 18 May 08:06                                                                |                | 841                                                                                                | 90°(6°)                |              |
|                                                                               | CME Lift-off: 18 May 07:00, Only 2 points                                   |                |                                                                                                    |                        |              |
| CME                                                                           | 18 May 09:26                                                                |                | 707                                                                                                | 226°(78°)              |              |
|                                                                               | CME Lift-off: 18 May 08:27                                                  |                |                                                                                                    |                        |              |
| C2.6                                                                          | 18 May 09:18                                                                | 18 May 09:35   | $2.00 \times 10^{-3}$                                                                              | N12E61                 |              |
|                                                                               | Peak at 09:25, SF, in AR9957 by G08 and SVI                                 |                |                                                                                                    |                        |              |
| C3.0                                                                          | 18 May 10:42                                                                | 18 May 12:09   | $1.10 \times 10^{-2}$                                                                              | S14E36                 |              |
|                                                                               | Peak at 11:39, SF, in AR9955 by G08 and RAM                                 |                |                                                                                                    |                        |              |
| CME                                                                           | 18 May 11:50                                                                |                | 614                                                                                                | 163°(46°)              |              |
|                                                                               | CME Lift-off: 18 May 10:56                                                  |                |                                                                                                    |                        |              |
| CME                                                                           | 18 May 13:27                                                                |                | 415                                                                                                | 222°(144°)             |              |
|                                                                               | CME Lift-off: 18 May 12:18                                                  |                |                                                                                                    |                        |              |
| C2.5                                                                          | 18 May 12:36                                                                | 18 May 12:42   | $8.30 \times 10^{-4}$                                                                              | N12E80                 |              |
|                                                                               | Peak at 12:39, SF, in AR9960? by G10 and SVI                                |                |                                                                                                    |                        |              |
| CME                                                                           | 18 May 16:06                                                                |                | 789                                                                                                | 103°(4°)               |              |
|                                                                               | CME Lift-off: 18 May 15:21, Only 3 points                                   |                |                                                                                                    |                        |              |
| C3.4                                                                          | 18 May 15:40                                                                | 18 May 15:48   | $1.40 \times 10^{-3}$                                                                              | N11E54                 |              |
|                                                                               | Peak at 15:44, SF, in AR9957 by G08 and HOL                                 |                |                                                                                                    |                        |              |
| C2.2                                                                          | 18 May 18:24                                                                | 18 May 18:33   | $1.00 \times 10^{-3}$                                                                              | N11E53                 |              |
|                                                                               | Peak at 18:29, SF, in AR9957 by G08 and RAM                                 |                |                                                                                                    |                        |              |

Table 1.: Type IV<sub>IP</sub> Radio Bursts and Associated Activity-Continued

| Obs. | Start<br>Universal Time | End                                         | $F_{\text{SXR}}^{\text{tot}}$<br>(J m <sup>-2</sup> )<br>$V_{\text{CME}}$<br>(km s <sup>-1</sup> ) | Position<br>PA - Width | Freq.<br>MHz |
|------|-------------------------|---------------------------------------------|----------------------------------------------------------------------------------------------------|------------------------|--------------|
| C1.4 | 18 May 21:22            | 18 May 21:31                                | $6.30 \times 10^{-4}$                                                                              | —                      |              |
|      |                         | Peak at 21:26, by G08                       |                                                                                                    |                        |              |
| C1.3 | 19 May 00:17            | 19 May 00:23                                | $3.90 \times 10^{-4}$                                                                              | —                      |              |
|      |                         | Peak at 00:20, by G08                       |                                                                                                    |                        |              |
| C1.4 | 19 May 01:38            | 19 May 01:49                                | $8.00 \times 10^{-4}$                                                                              | —                      |              |
|      |                         | Peak at 01:43, by G08                       |                                                                                                    |                        |              |
| CME  | 19 May 02:50            |                                             |                                                                                                    | 82°(8°)                |              |
|      |                         | Very PoorEvent                              |                                                                                                    |                        |              |
| C1.1 | 19 May 06:46            | 19 May 06:59                                | $8.00 \times 10^{-4}$                                                                              | N14E45                 |              |
|      |                         | Peak at 06:49, SF, in AR9957 by G08 and LEA |                                                                                                    |                        |              |
| C2.5 | 19 May 08:08            | 19 May 09:02                                | $6.10 \times 10^{-3}$                                                                              | —                      |              |
|      |                         | Peak at 08:34, by G08                       |                                                                                                    |                        |              |
| CME  | 19 May 08:50            |                                             |                                                                                                    | 90°(72°)               |              |
|      |                         | Very PoorEvent                              |                                                                                                    |                        |              |
| C1.4 | 19 May 14:07            | 19 May 14:12                                | $3.80 \times 10^{-4}$                                                                              | —                      |              |
|      |                         | Peak at 14:10, by G08                       |                                                                                                    |                        |              |
| C1.4 | 19 May 15:54            | 19 May 16:03                                | $6.80 \times 10^{-4}$                                                                              | —                      |              |
|      |                         | Peak at 15:58, by G08                       |                                                                                                    |                        |              |
| C2.3 | 19 May 16:18            | 19 May 16:24                                | $6.10 \times 10^{-4}$                                                                              | N08E37                 |              |
|      |                         | Peak at 16:22, SF, in AR9961 by G08 and HOL |                                                                                                    |                        |              |
| CME  | 19 May 18:06            |                                             | 448                                                                                                | 156°(7°)               |              |
|      |                         | CME Lift-off: 19 May 16:49                  |                                                                                                    |                        |              |
| C2.2 | 19 May 05:19            | 19 May 17:16                                | $1.30 \times 10^{-3}$                                                                              | S22E76                 |              |
|      |                         | Peak at 17:11, SF, in AR9961 by G08 and HOL |                                                                                                    |                        |              |
| C2.7 | 19 May 18:41            | 19 May 18:49                                | $1.10 \times 10^{-03}$                                                                             | —                      |              |
|      |                         | Peak at 18:46, by G08                       |                                                                                                    |                        |              |
| C3.1 | 19 May 19:09            | 19 May 19:19                                | $1.30 \times 10^{-03}$                                                                             | —                      |              |
|      |                         | Peak at 19:14, by G08                       |                                                                                                    |                        |              |
| CME  | 19 May 20:26            |                                             | 541                                                                                                | 225°(125°)             |              |
|      |                         | CME Lift-off: 19 May 19:45, Partial halo    |                                                                                                    |                        |              |
| C2.1 | 19 May 19:46            | 19 May 19:54                                | $9.20 \times 10^{-4}$                                                                              | —                      |              |
|      |                         | Peak at 19:50 by G08                        |                                                                                                    |                        |              |
| C2.8 | 19 May 20:01            | 19 May 20:27                                | $3.00 \times 10^{-3}$                                                                              | —                      |              |
|      |                         | Peak at 20:23 by G08                        |                                                                                                    |                        |              |
| C4.7 | 19 May 21:43            | 19 May 21:52                                | $1.90 \times 10^{-3}$                                                                              | —                      |              |
|      |                         | Peak at 21:48 by G08                        |                                                                                                    |                        |              |
| CME  | 20 May 00:50            |                                             | 192                                                                                                | 41°(93°)               |              |
|      |                         | CME Lift-off: 19 May 21:43                  |                                                                                                    |                        |              |
| C2.2 | 20 May 07:19            | 20 May 07:34                                | $1.10 \times 10^{-3}$                                                                              | —                      |              |
|      |                         | Peak at 07:33 by G08                        |                                                                                                    |                        |              |

Table 1.:Type IV<sub>IP</sub> Radio Bursts and Associated Activity-Continued

| Obs.  | Start<br>Universal Time | End                                            | $F_{\text{SXR}}^{\text{tot}}$<br>(J m <sup>-2</sup> )<br>$V_{\text{CME}}$<br>(km s <sup>-1</sup> ) | Position<br>PA - Width | Freq.<br>MHz |
|-------|-------------------------|------------------------------------------------|----------------------------------------------------------------------------------------------------|------------------------|--------------|
| C3.9  | 20 May 07:29            | 20 May 08:14                                   | $7.60 \times 10^{-3}$                                                                              | S23E74                 |              |
|       |                         | Peak at 08:05, SF, in AR9961 by G08 and LEA    |                                                                                                    |                        |              |
| CME   | 20 May 11:06            |                                                | 658                                                                                                | 134°(38°)              |              |
|       |                         | CME Lift-off: 20 May 10:13                     |                                                                                                    |                        |              |
| M4.7  | 20 May 10:14            | 20 May 10:34                                   |                                                                                                    | S22E76                 |              |
|       |                         | Peak at 10:29, in AR9961 by G08                |                                                                                                    |                        |              |
| M5.0  | 20 May 10:49            | 20 May 10:56                                   |                                                                                                    | S22E76                 |              |
|       |                         | Peak at 10:53, in AR9961 by G08                |                                                                                                    |                        |              |
| CME   | 20 May 16:50            |                                                | 196                                                                                                | 35°(91°)               |              |
|       |                         | CME Lift-off: 20 May 14:12, PoorEvent, C2 Only |                                                                                                    |                        |              |
| CME   | 20 May 15:50            |                                                | 553                                                                                                | 143°(69°)              |              |
|       |                         | CME Lift-off: 20 May 14:45                     |                                                                                                    |                        |              |
| X2.1, | 20 May 15:21            | 20 May 15:31                                   | $6.50 \times 10^{-2}$                                                                              | S21E65                 |              |
|       |                         | Peak at 15:27, 2N, in AR9961 by G08 and HOL    |                                                                                                    |                        |              |
| C4.1  | 20 May 18:15            | 20 May 18:25                                   | $2.10 \times 10^{-3}$                                                                              | S23E67                 |              |
|       |                         | Peak at 18:20, 1F, in AR9961 by G08 and HOL    |                                                                                                    |                        |              |
| C1.8  | 20 May 19:46            | 20 May 19:56                                   | $9.80 \times 10^{-4}$                                                                              | S24E70                 |              |
|       |                         | Peak at 19:51, SF, in AR9961 by G08 and HOL    |                                                                                                    |                        |              |
| C3.0  | 20 May 20:17            | 20 May 20:37                                   | $3.00 \times 10^{-3}$                                                                              | S21E62                 |              |
|       |                         | Peak at 20:24, SF, in AR9961 by G08 and HOL    |                                                                                                    |                        |              |
| C2.0  | 20 May 21:16            | 20 May 21:24                                   | $7.90 \times 10^{-4}$                                                                              | —                      |              |
|       |                         | Peak at 21:20, by G08                          |                                                                                                    |                        |              |
| CME   | 21 May 02:50            |                                                | 319                                                                                                | 307°(26°)              |              |
|       |                         | CME Lift-off: 21 May 01:06                     |                                                                                                    |                        |              |
| C2.2  | 21 May 01:39            | 0521 01:48                                     | $9.30 \times 10^{-4}$                                                                              | S24E58                 |              |
|       |                         | Peak at 01:44, SF, in AR9961 by G08 and LEA    |                                                                                                    |                        |              |
| CME   | 21 May 04:26            |                                                | 294                                                                                                | 314°(37°)              |              |
|       |                         | CME Lift-off: 21 May 02:50                     |                                                                                                    |                        |              |
| C4.8  | 21 May 04:58            | 21 May 05:10                                   | $2.20 \times 10^{-3}$                                                                              | N15E44                 |              |
|       |                         | Peak at 05:03, SF, in AR9960 by G08 and LEA    |                                                                                                    |                        |              |
| CME   | 21 May 10:50            |                                                | 283                                                                                                | 251°(73°)              |              |
|       |                         | CME Lift-off: 21 May 09:04                     |                                                                                                    |                        |              |
| C1.9  | 21 May 10:15            | 21 May 10:29                                   | $1.30 \times 10^{-3}$                                                                              | N12E29                 |              |
|       |                         | Peak at 10:21, SF, in AR9960 by G08 and SVI    |                                                                                                    |                        |              |
| C3.2  | 21 May 17:17            | 21 May 17:30                                   | $1.80 \times 10^{-3}$                                                                              | N11E69                 |              |
|       |                         | Peak at 17:23, SF, in AR9963 by G08 and RAM    |                                                                                                    |                        |              |
| CME   | 21 May 21:50            |                                                | 853                                                                                                | 54°(135°)              |              |
|       |                         | CME Lift-off: 21 May 21:11, Partial halo       |                                                                                                    |                        |              |
| M1.5  | 21 May 21:20            | 21 May 22:00                                   | $2.40 \times 10^{-2}$                                                                              | N17E38                 |              |
|       |                         | Peak at 21:39, 2F, in AR9960 by G08 and HOL    |                                                                                                    |                        |              |

Table 1.:Type IV<sub>IP</sub> Radio Bursts and Associated Activity-Continued

| Obs.    | Start<br>Universal Time | End                                         | $F_{\text{SXR}}^{\text{tot}}$<br>(J m <sup>-2</sup> )<br>$V_{\text{CME}}$<br>(km s <sup>-1</sup> ) | Position<br>PA - Width | Freq.<br>MHz |
|---------|-------------------------|---------------------------------------------|----------------------------------------------------------------------------------------------------|------------------------|--------------|
| C9.7    | 21 May 23:14            | 22 May 01:28                                | $5.00 \times 10^{-2}$                                                                              | —                      |              |
|         |                         | Peak at 22 May 00:30 by G08                 |                                                                                                    |                        |              |
| CME     | 22 May 00:06            |                                             | 1246                                                                                               | 272°(186°)             |              |
|         |                         | CME Lift-off: 21 May 23:38, Partial halo    |                                                                                                    |                        |              |
| CME     | 22 May 03:50            |                                             | 1557                                                                                               | 250° - halo            |              |
|         |                         | CME Lift-off: 21 May 03:15                  |                                                                                                    |                        |              |
| C5.0    | 22 May 03:18            | 22 May 05:02                                | $2.50 \times 10^{-2}$                                                                              | S22W53                 |              |
|         |                         | Peak at 03:54, SF by G08 and SVI            |                                                                                                    |                        |              |
| Type II | 22 May 04:10            | 23 May 10:40                                |                                                                                                    |                        | 0.50 - 0.03  |
|         |                         | FastType II by <i>Wind</i> /WAVES           |                                                                                                    |                        |              |
| CME     | 22 May 06:26            |                                             | 831                                                                                                | 258°(60°)              |              |
|         |                         | CME Lift-off: 22 May 05:29                  |                                                                                                    |                        |              |
| C1.7    | 22 May 08:24            | 22 May 08:48                                | $2.20 \times 10^{-3}$                                                                              |                        |              |
|         |                         | Peak at 08:31, by G08                       |                                                                                                    |                        |              |
| CME     | 22 May 09:50            |                                             | 559                                                                                                | 213°(37°)              |              |
|         |                         | CME Lift-off:22 May 09:14                   |                                                                                                    |                        |              |
| CME     | 22 May 12:06            |                                             | 444                                                                                                | 118°(30°)              |              |
|         |                         | CME Lift-off:22 May 10:53                   |                                                                                                    |                        |              |
| C2.5    | 22 May 15:39            | 22 May 15:55                                | $1.80 \times 10^{-3}$                                                                              | S23E44                 |              |
|         |                         | Peak at 15:47, SF, in AR9961 by G08 and RAM |                                                                                                    |                        |              |
| CME     | 22 May 20:26            |                                             | 305                                                                                                | 16°(46°)               |              |
|         |                         | CME Lift-off:22 May 18:52                   |                                                                                                    |                        |              |
| C2.4    | 22 May 20:48            | 22 May 20:59                                | $1.20 \times 10^{-3}$                                                                              | S23E40                 |              |
|         |                         | Peak at 20:54, SF, in AR9961 by G08 and HOL |                                                                                                    |                        |              |
| CME     | 22 May 22:06            |                                             | 212                                                                                                | 285°(66°)              |              |
|         |                         | CME Lift-off:Uncertain                      |                                                                                                    |                        |              |
| B9.5    | 23 May 01:01            | 23 May 01:14                                | $6.60 \times 10^{-4}$                                                                              | —                      |              |
|         |                         | Peak at 01:06 by G08                        |                                                                                                    |                        |              |
| C1.1    | 23 May 02:30            | 23 May 02:43                                | $7.70 \times 10^{-4}$                                                                              | —                      |              |
|         |                         | Peak at 02:35 by G08                        |                                                                                                    |                        |              |
| CME     | 23 May 09:50            |                                             | 318                                                                                                | 228°(17°)              |              |
|         |                         | CME Lift-off:23 May 08:46                   |                                                                                                    |                        |              |



| Table 1.:Type IV <sub>IP</sub> Radio Bursts and Associated Activity-Continued                                           |                         |               |                                                                                                    |                        |              |
|-------------------------------------------------------------------------------------------------------------------------|-------------------------|---------------|----------------------------------------------------------------------------------------------------|------------------------|--------------|
| Obs.                                                                                                                    | Start<br>Universal Time | End           | $F_{\text{SXR}}^{\text{tot}}$<br>(J m <sup>-2</sup> )<br>$V_{\text{CME}}$<br>(km s <sup>-1</sup> ) | Position<br>PA - Width | Freq.<br>MHz |
| Compact Event: 35 - 16 May 2002                                                                                         |                         |               |                                                                                                    |                        |              |
| Type II                                                                                                                 | 16 May 01:13            | 16 May 03:30  |                                                                                                    |                        | 40 - 2.0     |
| Type IV                                                                                                                 | 16 May 00:46            | 16 May 05:45  |                                                                                                    |                        | 600 - 7.0    |
| Type II (Intermittent tone) and IV <sub>IP</sub> with coronal extension<br>by <i>Wind</i> /WAVES, CUL and LEA           |                         |               |                                                                                                    |                        |              |
| Type III                                                                                                                | 16 May 01:35            | 16 May 05:30  |                                                                                                    |                        | 400 - 1.0L   |
| Intermittent Activity, by <i>Wind</i> /WAVES, CUL and LEA<br>with Largest Type III Group 0320-0500                      |                         |               |                                                                                                    |                        |              |
| C 4.5                                                                                                                   | 16 May 00:11            | 16 May 01:18  | $1.50 \times 10^{-2}$                                                                              |                        |              |
| Peak at 00:35 by G08                                                                                                    |                         |               |                                                                                                    |                        |              |
| CME                                                                                                                     | 16 May 00:50            |               | 600                                                                                                | 158° - halo            |              |
| CME Lift-off:15 May 23:45                                                                                               |                         |               |                                                                                                    |                        |              |
| CME(s)Preceding Main Ejection                                                                                           |                         |               |                                                                                                    |                        |              |
| CME                                                                                                                     | 15 May 23:06            |               | 698                                                                                                | 88°(93°)               |              |
| CME                                                                                                                     | 15 May 12:54            |               | 919                                                                                                | 89°(95°)               |              |
| Compact Event: 36 - 17 April 2002                                                                                       |                         |               |                                                                                                    |                        |              |
| Type II                                                                                                                 | 17 Apr. 08:30           | 19 Apr. 04:00 |                                                                                                    |                        | 5 - 0.040    |
| Type IV                                                                                                                 | 17 Apr. 08:03           | 17 Apr. 11:50 |                                                                                                    | S14W34                 | 243 - 8.0    |
| Type II (Intermittent bands) by <i>Wind</i> /WAVES and IV <sub>IP</sub> with coronal<br>extension by ART-4, LEA and NRH |                         |               |                                                                                                    |                        |              |
| Type III                                                                                                                | 17 Apr. 07:51           | 17 Apr. 09:03 |                                                                                                    |                        | 10 - 1.0L    |
| Type III Group (GG), by <i>Wind</i> /WAVES, ART-4, LEA and NRH                                                          |                         |               |                                                                                                    |                        |              |
| M2.6                                                                                                                    | 17 Apr. 07:46           | 17 Apr. 09:57 | $1.50 \times 10^{-1}$                                                                              | S14W34                 |              |
| Peak at 08:24, 2N, in AR9906 by G08 and SVI                                                                             |                         |               |                                                                                                    |                        |              |
| CME                                                                                                                     | 17 Apr. 08:26           |               | 1240                                                                                               | 292° - halo            |              |
| CME Lift-off:17 Apr. 07:50                                                                                              |                         |               |                                                                                                    |                        |              |
| CME(s)Preceding Main Ejection                                                                                           |                         |               |                                                                                                    |                        |              |
| CME                                                                                                                     | 16 Apr. 13:50           |               | 166                                                                                                | 290°(50°)              |              |
| CME                                                                                                                     | 16 Apr. 11:06           |               | 496                                                                                                | 262°(56°)              |              |
| CME                                                                                                                     | 15 Apr. 18:06           |               | 566                                                                                                | 240°(98°)              |              |

Table 1.: Type IV<sub>IP</sub> Radio Bursts and Associated Activity-Continued

| Obs.                                                                                                                      | Start<br>Universal Time | End           | $F_{\text{SXR}}^{\text{tot}}$<br>(J m <sup>-2</sup> )<br>$V_{\text{CME}}$<br>(km s <sup>-1</sup> ) | Position<br>PA - Width | Freq.<br>MHz |
|---------------------------------------------------------------------------------------------------------------------------|-------------------------|---------------|----------------------------------------------------------------------------------------------------|------------------------|--------------|
| Compact Event: 37 - 05 October 2001                                                                                       |                         |               |                                                                                                    |                        |              |
| Type II                                                                                                                   | 05 Oct. 10:12           | 05 Oct. 11:45 |                                                                                                    | S20W90                 | 80 - 1.2     |
| Type IV                                                                                                                   | 05 Oct. 10:10           | 05 Oct. 13:00 |                                                                                                    | S20W90                 | 100 - 7.0    |
| Type II (F-H) by <i>Wind</i> /WAVES, DAM, NRH and IV <sub>IP</sub> with coronal extension by <i>Wind</i> /WAVES, DAM, NRH |                         |               |                                                                                                    |                        |              |
| Type III                                                                                                                  | 05 Oct. 10:26           | 05 Oct. 10:30 |                                                                                                    |                        | 80 - 10L     |
| Group (GG), by <i>Wind</i> /WAVES, DAM, NRH                                                                               |                         |               |                                                                                                    |                        |              |
| C 2.5                                                                                                                     | 05 Oct. 08:13           | 05 Oct. 08:30 | $2.10 \times 10^{-3}$                                                                              |                        |              |
| Peak at 08:20 by G08                                                                                                      |                         |               |                                                                                                    |                        |              |
| C1.9                                                                                                                      | 05 Oct. 11:31           | 05 Oct. 11:39 | $8.30 \times 10^{-4}$                                                                              | S12W26                 |              |
| Peak at 11:35, SF, in AR9641 by G08 and SVI                                                                               |                         |               |                                                                                                    |                        |              |
| CME                                                                                                                       | 05 Oct. 10:30           |               | 1537                                                                                               | 222° - halo            |              |
| CME Lift-off: 05 Oct. 09:56                                                                                               |                         |               |                                                                                                    |                        |              |
| CME(s)Preceding Main Ejection                                                                                             |                         |               |                                                                                                    |                        |              |
| CME                                                                                                                       | 05 Oct. 09:30           |               | 219                                                                                                | 235° (54°)             |              |
| Compact Event: 38 - 01 October 2001                                                                                       |                         |               |                                                                                                    |                        |              |
| Type IV                                                                                                                   | 01 Oct. 06:30           | 01 Oct. 07:00 |                                                                                                    |                        | 4 - 10       |
| Type II                                                                                                                   | 01 Oct. 07:00           | 01 Oct. 18:30 |                                                                                                    |                        | 1 - 0.15     |
| Type IV <sub>IP</sub> and Strong II (F-H) by <i>Wind</i> /WAVES                                                           |                         |               |                                                                                                    |                        |              |
| Type II                                                                                                                   | 01 Oct. 06:07           | 01 Oct. 07:08 |                                                                                                    |                        | 90 - 30      |
| Type IV                                                                                                                   | 01 Oct. 05:34           | 01 Oct. 08:30 |                                                                                                    | S29W76                 | 210 - 10     |
| Coronal Type II/IV by HiRAS, LEA and NRH                                                                                  |                         |               |                                                                                                    |                        |              |
| Type III                                                                                                                  | 01 Oct. 04:46           | 01 Oct. 05:20 |                                                                                                    |                        | 144 - 1.0L   |
| Type III Group (GG), by <i>Wind</i> /WAVES, HiRAS, NRH                                                                    |                         |               |                                                                                                    |                        |              |
| M 9.1                                                                                                                     | 01 Oct. 04:41           | 01 Oct. 05:23 | $8.60 \times 10^{-2}$                                                                              | S29W76                 |              |
| Peak at 05:15, in AR9628? by G10                                                                                          |                         |               |                                                                                                    |                        |              |
| CME                                                                                                                       | 01 Oct. 05:30           |               | 1405                                                                                               | 225° - halo            |              |
| CME Lift-off: 01 Oct. 05:21                                                                                               |                         |               |                                                                                                    |                        |              |
| CME(s)Preceding Main Ejection                                                                                             |                         |               |                                                                                                    |                        |              |
| CME                                                                                                                       | 01 Oct. 01:54           |               |                                                                                                    | 220° (68°)             |              |

| Table 1.:Type IV <sub>IP</sub> Radio Bursts and Associated Activity-Continued |                                                                  |               |                                                                                                 |                        |              |
|-------------------------------------------------------------------------------|------------------------------------------------------------------|---------------|-------------------------------------------------------------------------------------------------|------------------------|--------------|
| Obs.                                                                          | Start<br>Universal Time                                          | End           | $F_{\text{SXR}}^{tot}$<br>(J m <sup>-2</sup> )<br><br>$V_{\text{CME}}$<br>(km s <sup>-1</sup> ) | Position<br>PA - Width | Freq.<br>MHz |
| Compact Event: 39-11 April 2001                                               |                                                                  |               |                                                                                                 |                        |              |
| Type II                                                                       | 11 Apr. 13:15                                                    | 11 Apr. 14:15 |                                                                                                 |                        | 14 - 1.50    |
| Type IV                                                                       | 11 Apr. 13:15                                                    | 11 Apr. 16:00 |                                                                                                 |                        | 14 - 9.0     |
|                                                                               | Type II (F-H) and IV <sub>IP</sub> by <i>Wind</i> /WAVES         |               |                                                                                                 |                        |              |
| Type II                                                                       | 11 Apr. 13:09                                                    |               |                                                                                                 |                        | 34 - 25L     |
| Type IV                                                                       | 11 Apr. 13:08                                                    | 11 Apr. 15:19 |                                                                                                 | S22W27                 | 180H - 25L   |
|                                                                               | Coronal Type II by SVI and IV by SVI, NRH                        |               |                                                                                                 |                        |              |
| Type III                                                                      | 11 Apr. 13:01                                                    | 11 Apr. 13:28 |                                                                                                 |                        | 180H - 1.0L  |
|                                                                               | Type III Group (GG), by <i>Wind</i> /WAVES, SVI, NRH             |               |                                                                                                 |                        |              |
| M2.3                                                                          | 11 Apr. 12:56                                                    | 11 Apr. 13:49 | $4.80 \times 10^{-2}$                                                                           | S22W27                 |              |
|                                                                               | Peak at 13:26, 1F, in AR9415 by G08 and RAM                      |               |                                                                                                 |                        |              |
| CME                                                                           | 11 Apr. 13:32                                                    |               | 1103                                                                                            | 224° - halo            |              |
|                                                                               | CME Lift-off: 11 Apr. 12:52                                      |               |                                                                                                 |                        |              |
| CME(s)Preceding Main Ejection                                                 |                                                                  |               |                                                                                                 |                        |              |
| CME                                                                           | 11 Apr. 06:30                                                    |               | 858                                                                                             | 238°(72°)              |              |
| CME                                                                           | 11 Apr. 00:54                                                    |               | 939                                                                                             | 247°(69°)              |              |
| Compact Event: 40-10 July 2000                                                |                                                                  |               |                                                                                                 |                        |              |
| Type II                                                                       | 10 July 22:00                                                    | 10 July 23:30 |                                                                                                 |                        | 14 - 1.0     |
| Type IV                                                                       | 10 July 22:00                                                    | 10 July 23:00 |                                                                                                 |                        | 14 - 5.0     |
|                                                                               | ComplexType II and IV <sub>IP</sub> by <i>Wind</i> /WAVES        |               |                                                                                                 |                        |              |
| Type II/IV                                                                    | 10 July 21:27                                                    | 10 July 23:05 |                                                                                                 |                        | 500H - 18    |
|                                                                               | Coronal Type II(F-H)/IV by CUL, HiRAS                            |               |                                                                                                 |                        |              |
| Type III                                                                      | 10 July 21:27                                                    | 10 July 22:53 |                                                                                                 |                        | 500H - 1.0L  |
|                                                                               | SeveralType III Groups (G-GG), by <i>Wind</i> /WAVES, CUL, HiRAS |               |                                                                                                 |                        |              |
| M5.7                                                                          | 10 July 21:05                                                    | 10 July 22:27 | $2.20 \times 10^{-1}$                                                                           | N18E49                 |              |
|                                                                               | Peak at 21:42, Peak 21:11, 2B, in AR9077 by G08 and HOL          |               |                                                                                                 |                        |              |
| CME                                                                           | 10 July 21:50                                                    |               | 1352                                                                                            | 94°(289°)              |              |
|                                                                               | CME Lift-off:10 July 21:12, Partial halo                         |               |                                                                                                 |                        |              |
| CME(s)Preceding Main Ejection                                                 |                                                                  |               |                                                                                                 |                        |              |
| CME                                                                           | 10 July 04:50                                                    |               | 623                                                                                             | 99°(59°)               |              |

| Table 1.:Type IV <sub>IP</sub> Radio Bursts and Associated Activity-Continued        |                         |               |                                                                                                    |                        |              |
|--------------------------------------------------------------------------------------|-------------------------|---------------|----------------------------------------------------------------------------------------------------|------------------------|--------------|
| Obs.                                                                                 | Start<br>Universal Time | End           | $F_{\text{SXR}}^{\text{tot}}$<br>(J m <sup>-2</sup> )<br>$V_{\text{CME}}$<br>(km s <sup>-1</sup> ) | Position<br>PA - Width | Freq.<br>MHz |
| Compact Event: 41 - 2000 June 17                                                     |                         |               |                                                                                                    |                        |              |
| Type II                                                                              | 17 June 03:00           | 17 June 04:15 |                                                                                                    |                        | 14 - 1.0     |
| Type IV                                                                              | 17 June 03:20           | 17 June 03:35 |                                                                                                    |                        | 14 - 7.0     |
| Type II and IV <sub>IP</sub> (Complex IV including U-bursts.), by <i>Wind</i> /WAVES |                         |               |                                                                                                    |                        |              |
| Type IV                                                                              | 17 June 02:47           | 17 June 04:43 |                                                                                                    |                        | 200H - 20L   |
| Coronal Type IV by CUL                                                               |                         |               |                                                                                                    |                        |              |
| Type III                                                                             | 17 June 02:34           | 17 June 04:39 |                                                                                                    |                        | 200H - 1.0L  |
| Type III Storm (S) by <i>Wind</i> /WAVES and CUL                                     |                         |               |                                                                                                    |                        |              |
| M3.5                                                                                 | 17 June 02:25           | 17 June 02:44 | $2.40 \times 10^{-2}$                                                                              | N22W72                 |              |
| Peak at 02:37, 2B, in AR9033 by G08 and LEA                                          |                         |               |                                                                                                    |                        |              |
| CME                                                                                  | 17 June 03:28           |               | 857                                                                                                | 301°(133°)             |              |
| CME Lift-off: 17 June 02:27, Partial halo                                            |                         |               |                                                                                                    |                        |              |
| CME(s)Preceding Main Ejection                                                        |                         |               |                                                                                                    |                        |              |
| CME                                                                                  | 15 June 22:06           |               | 362                                                                                                | 348°(102°)             |              |
| PoorEvent                                                                            |                         |               |                                                                                                    |                        |              |
| Compact Event: 42 - 2000 May 22                                                      |                         |               |                                                                                                    |                        |              |
| Type IV                                                                              | 22 May 01:30            | 22 May 03:30  |                                                                                                    |                        | 14 - 6.0     |
| Type IV <sub>IP</sub> , by <i>Wind</i> /WAVES                                        |                         |               |                                                                                                    |                        |              |
| Type IV                                                                              | 22 May 01:16            | 22 May 04:00D |                                                                                                    |                        | 200H - 20L   |
| Coronal Type IV, by CUL                                                              |                         |               |                                                                                                    |                        |              |
| Type III                                                                             | 22 May 01:16            | 22 May 01:46  |                                                                                                    |                        | 200H - 1.0L  |
| Group (GG), by <i>Wind</i> /WAVES, CUL                                               |                         |               |                                                                                                    |                        |              |
| C6.3                                                                                 | 22 May 01:20            | 22 May 02:54  | $2.90 \times 10^{-2}$                                                                              |                        |              |
| Peak at 02:01 by G08                                                                 |                         |               |                                                                                                    |                        |              |
| CME                                                                                  | 22 May 01:50            |               | 649                                                                                                | 245° - halo            |              |
| CME Lift-off: 22 May 00:55                                                           |                         |               |                                                                                                    |                        |              |
| CME(s)Preceding Main Ejection                                                        |                         |               |                                                                                                    |                        |              |
| CME                                                                                  | 22 May 01:27            |               | 689                                                                                                | 203°(119°)             |              |

| Table 1.:Type IV <sub>IP</sub> Radio Bursts and Associated Activity-Continued |                         |                |                                                                                                    |                        |              |
|-------------------------------------------------------------------------------|-------------------------|----------------|----------------------------------------------------------------------------------------------------|------------------------|--------------|
| Obs.                                                                          | Start<br>Universal Time | End            | $F_{\text{SXR}}^{\text{tot}}$<br>(J m <sup>-2</sup> )<br>$V_{\text{CME}}$<br>(km s <sup>-1</sup> ) | Position<br>PA - Width | Freq.<br>MHz |
| Compact Event: 43 - 27 April 2000                                             |                         |                |                                                                                                    |                        |              |
| Type IV                                                                       | 27 Apr. 14:40           | 27 Apr. 14:55  |                                                                                                    |                        | 14 - 5.0     |
| Possible Type IV <sub>IP</sub> , by <i>Wind</i> /WAVES                        |                         |                |                                                                                                    |                        |              |
| Type IV                                                                       | 27 Apr. 09:00           | 27 Apr. 15:00D |                                                                                                    | N40E00                 | 100 - 400    |
| Coronal Type IV by ART-IV and NRH (Frequency GAP 100 - 14 MHz)                |                         |                |                                                                                                    |                        |              |
| B9.4                                                                          | 27 Apr. 13:52           | 27 Apr. 13:59  | $3.10 \times 10^{-4}$                                                                              |                        |              |
| Peak at 13:57 by G08                                                          |                         |                |                                                                                                    |                        |              |
| B9.8                                                                          | 27 Apr. 14:04           | 27 Apr. 14:56  | $2.40 \times 10^{-3}$                                                                              |                        |              |
| Peak at 14:40 by G08                                                          |                         |                |                                                                                                    |                        |              |
| CME                                                                           | 27 Apr. 12:30           |                | 764                                                                                                | 123°(122°)             |              |
| CME Lift-off: 27 Apr. 11:42, Uncertain Width, Partial halo                    |                         |                |                                                                                                    |                        |              |
| CME                                                                           | 27 Apr. 14:30           |                | 1110                                                                                               | 301°(138°)             |              |
| CME Lift-off: 27 Apr. 13:50, Partial halo                                     |                         |                |                                                                                                    |                        |              |
| CME(s)Preceding Main Ejection                                                 |                         |                |                                                                                                    |                        |              |
| CME                                                                           | 26 Apr. 16:19           |                | 212                                                                                                | 153°(31°)              |              |
| CME                                                                           | 25 Apr. 16:06           |                | 672                                                                                                | 296°(34°)              |              |
| CME                                                                           | 25 Apr. 14:06           |                | 189                                                                                                | 263°(49°)              |              |
| Compact Event: 44 - 11 June 1999                                              |                         |                |                                                                                                    |                        |              |
| Type II                                                                       | 11 June 11:45           | 11 June 17:00  |                                                                                                    |                        | 14 - 0.40    |
| Type IV                                                                       | 11 June 11:30           | 11 June 12:20  |                                                                                                    |                        | 14 - 7.0     |
| Type IV <sub>IP</sub> and II, by <i>Wind</i> /WAVES                           |                         |                |                                                                                                    |                        |              |
| Type II/IV                                                                    | 11 June 11:16           | 11 June 11:45  |                                                                                                    | N30E90                 | 35L - 300    |
| Coronal Type II/IV by IZM, ART-IV and NRH                                     |                         |                |                                                                                                    |                        |              |
| Type III                                                                      | 11 June 11:12           | 11 June 12:11  |                                                                                                    |                        | 500 - 1.0L   |
| Four Groups (G-GG), by <i>Wind</i> /WAVES, IZM and ART-IV                     |                         |                |                                                                                                    |                        |              |
| C8.8                                                                          | 11 June 11:07           | 11 June 12:31  | $3.10 \times 10^{-2}$                                                                              |                        |              |
| Peak at 11:57 by G10                                                          |                         |                |                                                                                                    |                        |              |
| CME                                                                           | 11 June 11:26           |                | 1569                                                                                               | 38°(181°)              |              |
| CME Lift-off: 11 June 11:05, Uncertain Width, Partial halo                    |                         |                |                                                                                                    |                        |              |
| CME(s)Preceding Main Ejection                                                 |                         |                |                                                                                                    |                        |              |
| CME                                                                           | 10 June 14:50           |                | 412                                                                                                | 87°(115°)              |              |
| CME                                                                           | 10 June 11:50           |                | 215                                                                                                | 78°(55°)               |              |
| PoorEvent                                                                     |                         |                |                                                                                                    |                        |              |

Table 1.: Type IV<sub>IP</sub> Radio Bursts and Associated Activity-Continued

| Obs.                                | Start<br>Universal Time                                     | End           | $F_{\text{SXR}}^{\text{tot}}$<br>(J m <sup>-2</sup> )<br>$V_{\text{CME}}$<br>(km s <sup>-1</sup> ) | Position<br>PA - Width | Freq.<br>MHz |
|-------------------------------------|-------------------------------------------------------------|---------------|----------------------------------------------------------------------------------------------------|------------------------|--------------|
| Extended Event: 45 - 27-28 May 1999 |                                                             |               |                                                                                                    |                        |              |
| Type II/IV                          | 27 May 10:55                                                | 28 May 15:00  |                                                                                                    |                        | 14 - 0.070   |
|                                     | Type IV <sub>IP</sub> followed by II, by <i>Wind</i> /WAVES |               |                                                                                                    |                        |              |
| Type IV                             | 27 May 10:55                                                | 27 May 15:00D |                                                                                                    | N18E31                 | 25L - 70H    |
| Type IV                             | 28 May 11:30                                                | 28 May 15:00D |                                                                                                    | N18E31                 | 25L - 70H    |
|                                     | Two Coronal Type IV, by SVI, DAM and NRH                    |               |                                                                                                    |                        |              |
| Type II                             | 27 May 10:48                                                | 27 May 10:55  |                                                                                                    |                        | 20 - 55      |
|                                     | Type II, by DAM                                             |               |                                                                                                    |                        |              |
| Type III                            | 27 May 10:55                                                | 27 May 11:08  |                                                                                                    |                        | 20 - 70      |
|                                     | Type III Group (GG) , by DAM                                |               |                                                                                                    |                        |              |
| C1.2                                | 27 May 09:13                                                | 27 May 09:20  | $4.00 \times 10^{-4}$                                                                              | N31W07                 |              |
|                                     | Peak at 09:17, SF, in AR8551 by G08 and SVI                 |               |                                                                                                    |                        |              |
| C4.5                                | 27 May 11:36                                                | 27 May 11:54  | $3.40 \times 10^{-3}$                                                                              | S30E78                 |              |
|                                     | Peak at 11:43, SF, in AR8557 by G08 and RAM                 |               |                                                                                                    |                        |              |
| C3.4                                | 27 May 12:59                                                | 27 May 13:09  | $1.60 \times 10^{-3}$                                                                              | N18E31                 |              |
|                                     | Peak at 13:04, 1F, in AR8552 by G08 and HOL                 |               |                                                                                                    |                        |              |
| C2.7                                | 27 May 14:23                                                | 27 May 15:05  | $5.90 \times 10^{-3}$                                                                              | S22W76                 |              |
|                                     | Peak at 14:40, SF, in AR8548 by G08 and RAM                 |               |                                                                                                    |                        |              |
| C6.2                                | 27 May 15:15                                                | 27 May 16:03  | $1.40 \times 10^{-2}$                                                                              | S26E81                 |              |
|                                     | Peak at 15:35, SF, in AR8557 by G08 and HOL                 |               |                                                                                                    |                        |              |
| C7.4                                | 27 May 16:49                                                | 27 May 17:08  | $7.60 \times 10^{-3}$                                                                              | N38W76                 |              |
|                                     | Peak at 16:59, SF, in AR8545 by G08 and RAM                 |               |                                                                                                    |                        |              |
| C2.3                                | 27 May 18:33                                                | 27 May 19:13  | $5.00 \times 10^{-3}$                                                                              | N17E29                 |              |
|                                     | Peak at 18:59, SF, in AR8552 by G08 and COM                 |               |                                                                                                    |                        |              |
| C2.3                                | 28 May 05:49                                                | 28 May 05:58  | $8.90 \times 10^{-4}$                                                                              | N12E81                 |              |
|                                     | Peak at 05:53, SF, in AR8558 by G08 and COM                 |               |                                                                                                    |                        |              |
| C1.2                                | 28 May 08:23                                                | 28 May 08:40  | $1.10 \times 10^{-3}$                                                                              |                        |              |
|                                     | Peak at 08:31 by G10                                        |               |                                                                                                    |                        |              |
| CME                                 | 27 May 11:06                                                |               | 1691                                                                                               | 341° - halo            |              |
|                                     | CME Lift-off: 27 May 10:33                                  |               |                                                                                                    |                        |              |
| CME                                 | 27 May 14:50                                                |               | 646                                                                                                | 61° (140°)             |              |
|                                     | CME Lift-off: 27 May 13:36, Partial halo                    |               |                                                                                                    |                        |              |
| CME                                 | 27 May 16:26                                                |               | 798                                                                                                | 116° (94°)             |              |
|                                     | CME Lift-off: 27 May 15:23                                  |               |                                                                                                    |                        |              |
| CME                                 | 27 May 19:27                                                |               | 595                                                                                                | 46° (122°)             |              |
|                                     | CME Lift-off: 27 May 17:41, Partial halo, 3 points          |               |                                                                                                    |                        |              |
| CME                                 | 28 May 09:50                                                |               | 411                                                                                                | 110° (75°)             |              |
|                                     | CME Lift-off: 28 May 09:06                                  |               |                                                                                                    |                        |              |
| CME                                 | 28 May 10:26                                                |               | 206                                                                                                | 12° (104°)             |              |
|                                     | CME Lift-off: 28 May 07:48                                  |               |                                                                                                    |                        |              |

| Table 1.:Type IV <sub>IP</sub> Radio Bursts and Associated Activity-Continued |                                                                                            |                                               |                                                                                             |                        |              |
|-------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------|-----------------------------------------------|---------------------------------------------------------------------------------------------|------------------------|--------------|
| Obs.                                                                          | Start<br>Universal Time                                                                    | End                                           | $F_{\text{SXR}}^{tot}$<br>(J m <sup>-2</sup> )<br>$V_{\text{CME}}$<br>(km s <sup>-1</sup> ) | Position<br>PA - Width | Freq.<br>MHz |
| <hr/>                                                                         |                                                                                            |                                               |                                                                                             |                        |              |
| Compact Event: 46- 03 May 1998                                                |                                                                                            |                                               |                                                                                             |                        |              |
| Type IV                                                                       | 03 May 22:30                                                                               | 03 May 23:00                                  |                                                                                             |                        | 14- 8.0      |
|                                                                               |                                                                                            | Type IV <sub>IP</sub> , by <i>Wind</i> /WAVES |                                                                                             |                        |              |
| M1.4                                                                          | 03 May 21:12                                                                               | 03 May 21:49                                  | $2.10 \times 10^{-2}$                                                                       | N25E26                 |              |
|                                                                               |                                                                                            | Peak at 21:29, in AR8214 by G09               |                                                                                             |                        |              |
| CME                                                                           | 03 May 22:03                                                                               |                                               | 649                                                                                         | 302°(194°)             |              |
|                                                                               |                                                                                            | CME Lift-off: 03 May 20:58                    |                                                                                             |                        |              |
| <hr/>                                                                         |                                                                                            |                                               |                                                                                             |                        |              |
| CME(s)Preceding Main Ejection                                                 |                                                                                            |                                               |                                                                                             |                        |              |
| CME                                                                           | 03 May 03:17                                                                               |                                               | 399                                                                                         | 296°(22°)              |              |
| CME                                                                           | 02 May 14:06                                                                               |                                               | 938                                                                                         | 331° - halo            |              |
| <hr/>                                                                         |                                                                                            |                                               |                                                                                             |                        |              |
| Compact Event: 47- 02 May 1998                                                |                                                                                            |                                               |                                                                                             |                        |              |
| Type II                                                                       | 02 May 14:25                                                                               | 02 May 14:50                                  |                                                                                             |                        | 5.0- 3.0     |
| Type IV                                                                       | 02 May 14:10                                                                               | 02 May 15:40                                  |                                                                                             |                        | 14- 8.0      |
|                                                                               | Possible Type II (Narrowband wisps) and Broadband IV <sub>IP</sub> , by <i>Wind</i> /WAVES |                                               |                                                                                             |                        |              |
| Type II                                                                       | 02 May 13:30                                                                               | 02 May 13:46                                  |                                                                                             |                        | 400- 6.0     |
|                                                                               | Type II (Multiple Bands), by <i>Wind</i> /WAVES, ART-IV and DAM                            |                                               |                                                                                             |                        |              |
| Type III                                                                      | 02 May 13:34                                                                               | 02 May 14:00                                  |                                                                                             |                        | 600H- 1.0L   |
|                                                                               | Group (GG) by <i>Wind</i> /WAVES, ART-IV and DAM                                           |                                               |                                                                                             |                        |              |
| Type IV                                                                       | 02 May 13:30                                                                               | 02 May 15:36                                  |                                                                                             | S15W15                 | 600H- 20     |
|                                                                               | Coronal Type IV by NRH, ART-IV and DAM                                                     |                                               |                                                                                             |                        |              |
| X1.1                                                                          | 02 May 13:31                                                                               | 02 May 13:51                                  | $6.70 \times 10^{-2}$                                                                       | S15W15                 |              |
|                                                                               | Peak at 13:42, 3B, in AR8210 by G09 and RAM                                                |                                               |                                                                                             |                        |              |
| CME                                                                           | 02 May 14:06                                                                               |                                               | 938                                                                                         | 331° - halo            |              |
|                                                                               | CME Lift-off: 02 May 13:07                                                                 |                                               |                                                                                             |                        |              |
| <hr/>                                                                         |                                                                                            |                                               |                                                                                             |                        |              |
| CME(s)Preceding Main Ejection                                                 |                                                                                            |                                               |                                                                                             |                        |              |
| CME                                                                           | 02 May 05:32                                                                               |                                               | 542                                                                                         | 154° - halo            |              |
| CME                                                                           | 01 May 23:40                                                                               |                                               | 585                                                                                         | 126° - halo            |              |
| <hr/>                                                                         |                                                                                            |                                               |                                                                                             |                        |              |
| Only C3                                                                       |                                                                                            |                                               |                                                                                             |                        |              |
| <hr/>                                                                         |                                                                                            |                                               |                                                                                             |                        |              |
| Compact Event: 48- 29 April 1998                                              |                                                                                            |                                               |                                                                                             |                        |              |
| Type IV                                                                       | 29 Apr. 17:00                                                                              | 29 Apr. 18:15                                 |                                                                                             |                        | 14- 8.0      |
| Type II                                                                       | 29 Apr. 16:30                                                                              | 29 Apr. 17:00                                 |                                                                                             |                        | 10- 2.0      |
|                                                                               | Possible Type IV <sub>IP</sub> and Broadband II, by <i>Wind</i> /WAVES                     |                                               |                                                                                             |                        |              |
| M6.8                                                                          | 29 Apr. 16:06                                                                              | 29 Apr. 16:59                                 | $1.00 \times 10^{-1}$                                                                       | S18E20                 |              |
|                                                                               | Peak at 16:37, 3B, in AR8210 by G09 and HOL                                                |                                               |                                                                                             |                        |              |
| Type III                                                                      | 29 Apr. 16:06                                                                              | 29 Apr. 17:15                                 |                                                                                             |                        | 14H- 1.0L    |
|                                                                               | Group (GG) by <i>Wind</i> /WAVES, No Data above 14 MHz                                     |                                               |                                                                                             |                        |              |
| CME                                                                           | 29 Apr. 16:59                                                                              |                                               | 1374                                                                                        | 336° - halo            |              |
|                                                                               | CME Lift-off: 29 Apr. 16:22                                                                |                                               |                                                                                             |                        |              |

Table 1.:Type IV<sub>IP</sub> Radio Bursts and Associated Activity-Continued

| Obs.                          | Start<br>Universal Time | End | $F_{\text{SXR}}^{\text{tot}}$<br>(J m <sup>-2</sup> )<br>$V_{\text{CME}}$<br>(km s <sup>-1</sup> ) | Position<br>PA - Width | Freq.<br>MHz |
|-------------------------------|-------------------------|-----|----------------------------------------------------------------------------------------------------|------------------------|--------------|
| CME(s)Preceding Main Ejection |                         |     |                                                                                                    |                        |              |
| CME                           | 27 Apr. 08:56           |     | 1385                                                                                               | 79° - halo             |              |